Final Remedial Action Plan
Oakland Army Base
Oakland, California

Prepared for

Oakland Base Reuse Authority
and
Department of Toxic Substances Control
California Environmental Protection Agency

Prepared by

Erler & Kalinowski, Inc.

(EKI A10063.00)

27 September 2002

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Ms. Aliza Gallo
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Subject: Final Remedial Action Plan and Final Risk Management Plan
Oakland Army Base, Oakland, California
(EKI A10063.00)

Dear Ms. Gallo:

Erler & Kalinowski, Inc. ("EKI") is pleased to submit the enclosed Final Remedial Action Plan ("RAP") that includes the Final Risk Management Plan ("RMP") as Appendix E. The Final RAP and Final RMP were prepared by EKI in accordance with Task 6 of our Agreement, Work Authorization No. 2, effective 26 February 2002. Although the RMP is an appendix to the RAP, it is provided in a separate binder.

The Final RAP and Final RMP describe environmental remediation proposed for those portions of the Oakland Army Base ("OARB") that are scheduled to be transferred to the Oakland Base Reuse Authority ("OBRA") by the United States Department of Defense, Department of the Army ("Army") in an Economic Development Conveyance ("EDC"). These documents have been prepared on behalf of OBRA and, at your request, in consultation with, and on behalf of, the California Environmental Protection Agency, Department of Toxic Substances Control ("DTSC").

Please call if you have any questions.

Very truly yours,
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LIST OF ABBREVIATIONS AND ACRONYMS

ACE	U.S. Army Corps of Engineers
1,1-DCE	1,1-dichloroethene
AAFES	Army and Air Force Exchange Services
ACM	asbestos-containing material
Amended Reuse Plan	*Amended Draft Final Reuse Plan for the Oakland Army Base*
Antidegradation Policy	SWRCB Resolution No. 68-16
ARARs	Applicable or Relevant and Appropriate Requirements
Army	United States Department of Defense, Department of the Army
ARPA	Archeological Resources Protection Act
AST	aboveground storage tank
ATSDR	United States Department of Health and Human Services, Agency for Toxic Substances and Disease Registry
BAAQMD	Bay Area Air Quality Management District
BAT	Best Available Technology
Bay Plan	*San Francisco Bay Plan*
BCDC	San Francisco Bay Conservation and Development Commission
BCP	*Base Realignment and Closure Cleanup Plan*
bgs	below ground surface
BRAC	Base Realignment and Closure
BTEX	benzene, toluene, ethylbenzene, and xylenes
CAA	Clean Air Act
Cal / EPA	California Environmental Protection Agency
Caltrans	California Department of Transportation
CAMU	corrective action management unit
CCA	chromated copper arsenate

LIST OF ABBREVIATIONS AND ACRONYMS

CCR	California Code of Regulations
CDM	Camp Dresser & McKee, Inc.
CEDA	City of Oakland Community and Economic Development Agency
CERCLA	Comprehensive Environmental Responsibility, Compensation, and Liability Act
CESA	California Endangered Species Act
CFR	Code of Federal Regulations
cis-1,2-DCE	cis-1,2-dichloroethene
COC	chemical of concern
CTR	California Toxics Rule
CWA	Clean Water Act
cy	cubic yard
CZMA	Coastal Zone Management Act
DHS	State of California Department of Health Services
DOI	Department of the Interior
DPT	direct push technology
DTSC	Department of Toxic Substances Control, California Environmental Protection Agency
EBEP	*California Enclosed Bays and Estuaries Plan, Water Quality Control Plan for Enclosed Bays and Estuaries of California*
EBMUD	East Bay Municipal Utility District
EBRPD	East Bay Regional Parks District
EBS	Environmental Baseline Survey
EDC	Economic Development Conveyance
EIR	Environmental Impact Report
EIS	Environmental Impact Statement
EKI	Erler & Kalinowski, Inc.

LIST OF ABBREVIATIONS AND ACRONYMS

ESA	Federal Endangered Species Act
ESCA	Environmental Service Cooperative Agreement
FOSET	Finding of Suitability for Early Transfer
FOST	Finding of Suitability for Transfer
Foster Wheeler	Foster Wheeler Environmental Corporation
FS	feasibility study
GAC	granular activated carbon
GDA	Gateway Development Area
GWRTAC	Ground-Water Remediation Technologies Analysis Center
HC	Homeless Collaborative
HDPE	high density polyethylene
HEAST	Health Effects Assessment Summary Table
HI	Hazard Index
HRC	Hydrogen Release Compound™
HSC	California Health and Safety Code
HSWA	Hazardous and Solid Waste Amendments of 1984
ICP	Inductively Coupled Plasma
ICP-MS	Inductively Coupled Plasma–Mass Spectrometry
IRIS	Integrated Risk Information System
ISWP	*California Inland Surface Waters Plan, Water Quality Control Plan for Inland Surface Waters of California*
ITSI	Innovative Technical Solutions, Inc.
LBNL	Lawrence Berkeley National Laboratory
LBP	lead-based paint
LDR	land disposal restriction
lf	linear feet

LIST OF ABBREVIATIONS AND ACRONYMS

LLDPE	linear low density polyethylene
LRA	Local Reuse Authority
MCL	Maximum Contaminant Level
MCLG	Maximum Contaminant Level Goal
µg/dl	micrograms per deciliter
MNA	monitored natural attenuation
MTBE	methyl tertiary butyl ether
NAGPRA	Native American Graves Protection and Repatriation Act
NAPL	non-aqueous phase liquid
National Register	National Register of Historic Places
NCEA	National Center for Environmental Assessment
NCP	National Oil and Hazardous Substances Pollution Contingency Plan
NEPA	National Environmental Policy Act
NHPA	National Historic Preservation Act
NTU	nephelometric turbidity unit
OARB	Oakland Army Base
OBRA	Oakland Base Reuse Authority
OEHHA	Office of Environmental Health Hazard Assessment
OMI	Oakland Military Institute College Preparatory Academy
ORA	Oakland Redevelopment Agency
ORC	Oxygen Release Compound™
ORP	oil reclaiming plant
PA/SI	Preliminary Assessment/Site Inspection
PAH	polycyclic aromatic hydrocarbon

LIST OF ABBREVIATIONS AND ACRONYMS

PBC	Public Benefit Conveyance
PCB	polychlorinated biphenyl
PCDD	polychlorinated dibenzodioxin
PCDF	polychlorinated dibenzofuran
PCE	tetrachloroethene
PCP	pentachlorophenol
PDA	Port Development Area
PEA	Preliminary Endangerment Assessment
Phase II Investigations	Investigations conducted by Army and OBRA in April and May 2002
PID	photoionization detector
Porter-Cologne	Porter-Cologne Water Quality Act
POTW	publicly owned treatment works
PRG	Preliminary Remediation Goal
QA / QC	quality assurance / quality control
RAO	remedial action objective
RAP	Remedial Action Plan
RBSL	risk-based screening level
RCRA	Resource Conservation and Recovery Act
R*f*D	reference dose
RG_c	soil remediation goal based on carcinogenic effects
RG_{nc}	soil remediation goal based on non-carcinogenic effects
RI	remedial investigation

LIST OF ABBREVIATIONS AND ACRONYMS

RME	reasonable maximum exposure
RMP	Risk Management Plan
RWQCB	Regional Water Quality Control Board, San Francisco Bay Region
SARA	Superfund Amendments and Reauthorization Act of 1986
Seaport Plan	*San Francisco Bay Area Seaport Plan*
sf	square foot or square feet
SF	slope factor
SIP	State Implementation Plan
Soil Lead Guidance	*Revised Interim Soil Lead Guidance for CERCLA Sites and RCRA Corrective Action Facilities*
SSD	sub-slab depressurization system
STLC	Soluble Threshold Limit Concentration
SVE	soil vapor extraction
SVOC	semi-volatile organic compound
SW 846	*Test Methods for Evaluating Solid Waste*
SWRCB	State Water Resources Control Board
TBCs	To-Be-Considered
TCE	trichloroethene
TCLP	Toxicity Characteristic Leaching Procedure
TCP	1,2,3-trichloropropane
TDS	total dissolved solids
Title 22 metals	metals regulated under 22 CCR §66261.24
TPH	total petroleum hydrocarbons

LIST OF ABBREVIATIONS AND ACRONYMS

TPHg	TPH quantified as gasoline
TPHd	TPH quantified as diesel
TPHmo	TPH quantified as motor oil
trans-1,2-DCE	trans-1,2-dichloroethene
TSCA	Toxic Substances Control Act
TTLC	Total Threshold Limit Concentration
U.S.C.	United States Code
U.S. EPA	United States Environmental Protection Agency
ULR	Urban Land Redevelopment
USATHAMA	United States Army Toxic and Hazardous Materials Agency
UST	underground storage tank
VOC	volatile organic compound
WET	Waste Extraction Test

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1. EXECUTIVE SUMMARY

1.1 PURPOSE OF REMEDIAL ACTION PLAN

This Remedial Action Plan ("RAP") has been prepared on behalf of the Oakland Base Reuse Authority ("OBRA") and California Environmental Protection Agency ("Cal / EPA"), Department of Toxic Substances Control ("DTSC"). The RAP identifies and evaluates potential remedial alternatives for sites of environmental concern at the Oakland Army Base ("OARB") in Oakland, California, and recommends remedies for implementation at OARB (Figure 1-1).

The portions of the OARB that are covered by this RAP are scheduled to be transferred to OBRA by the United States Department of Defense, Department of the Army ("Army") via an Economic Development Conveyance ("EDC") prior to the completion of all required environmental remediation. This early transfer requires that both the State of California and the Army find that all required remediation will be undertaken after transfer ("Finding of Suitability for Early Transfer" or "FOSET").

The RAP has been prepared consistent with requirements for preparing a RAP under Section 25356.1 of Chapter 6.8 of the California Health and Safety Code ("HSC") including as referenced therein the National Oil and Hazardous Substances Pollution Contingency Plan ("NCP"), set forth in Part 300, Title 40 of the Code of Federal Regulations ("CFR"). Upon approval, this RAP and its appended Risk Management Plan ("RMP") (Appendix E), which constitutes an element of the recommended remedies, will set forth the remediation program that will be implemented at subject portions of the OARB to satisfy applicable state and federal requirements consistent with the FOSET.

1.2 AREAS EXCLUDED FROM REMEDIAL ACTION PLAN

Under the Environmental Service Cooperative Agreement ("ESCA") to be signed between the Army and OBRA, the Army retains responsibility for cleanup of radiological materials, chemical and biologic warfare agents, and unexploded ordnance, if any, that may be present at the OARB. None of these materials are known to be present based on site investigation activities that have occurred over the past six years.

Besides environmental issues which the Army retains responsibility, necessary remediation, if any, of OARB property that is not being transferred to OBRA via the

EDC is not considered in this RAP / RMP[1,2]. The following property is not addressed in this RAP / RMP:

- Former Base Realignment and Closure ("BRAC") Parcel 1[3] or "Spit" totaling approximately 12.8 acres to be transferred to the Department of Interior ("DOI") on behalf of the East Bay Regional Parks District ("EBRPD") through a Public Benefit Conveyance ("PBC"), shown in pink on Figures 1-2 and 4-1. An additional area of approximately 6.4 acres of submerged land, including marine sediments at Outfall 4, are also defined to be part of the "Spit" that is not being transferred via the EDC.

- Army Reserve parcels totaling approximately 26 acres, which comprised former Army BRAC Parcels 6, 7, and 18, and portions of former BRAC Parcels 19 and 21, shown in yellow on Figure 4-1.

- Any property that is not being transferred via the EDC.

1.3 INTENDED REUSE OF OARB

Congress passed legislation in 1995 that designated closure of the OARB for military purposes under the BRAC program. OBRA was created to assist with the closure process as the Local Reuse Authority ("LRA"). The *Redevelopment Environmental Impact Report* ("EIR") prepared on behalf of the City of Oakland, Oakland Redevelopment Agency ("ORA") and OBRA (collectively referred to herein as "City"), indicates that approximately 133 acres of the OARB will be redeveloped with a variety of commercial and industrial uses as part of the Gateway Development Area ("GDA"). Approximately 233 acres (including 56 acres of submerged lands) will be employed for maritime, rail,

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[1] The OARB property being transferred to OBRA excludes approximately 20 acres of OARB property, primarily located beneath I-880, which was transferred from the Federal Highway Administration to the California Department of Transportation ("CalTrans") in March of 2002. Litigation regarding this transfer is ongoing; however, this Caltrans property is not currently being planned for transfer from the Army to OBRA and, thus, is not subject to this RAP.

[2] Off-site property adjacent to the EDC area that may be contaminated from Army activities is excluded from the RAP / RMP except for groundwater contamination caused exclusively by Army activities that occurred on the EDC area. Off-site areas excluded from the EDC area and the RAP / RMP include, for example, former Parcel 1 and off-site pesticide releases described in Section 4.4.3.6 of the RAP.

[3] As discussed in Section 4.1, BRAC Parcels and OUs are terminology that was employed by the Army in administrating its environmental program at the OARB. Such terminology is not used in this RAP/RMP to describe chemical release sites. Chemical release sites are referenced in the RAP/RMP by the designations assigned on Army maps and facility records to the tank, structure or building that was involved with a given release.

and other port activities as part of the Port Development Area ("PDA"). Details of the redevelopment strategy are presented in OBRA's *Amended Draft Final Reuse Plan for the Oakland Army Base (OARB)*, dated 23 July 2001 ("Amended Reuse Plan"). The Port of Oakland's specific land use objectives are presented in its *Strategic Plan Summary, Fiscal Years 2002-2006*, dated June 2001. The combined City / Port of Oakland projects are evaluated in the EIR.

Land surrounding the OARB is zoned Industrial (M) by the City of Oakland. The OARB itself is zoned Heavy Industrial (M-40). Port of Oakland harbor facilities lie west and south of the OARB. Current land uses on and near the OARB are industrial. The nearest off-site residential land use is located approximately 1,000 feet southeast of the OARB and is entirely separated from the OARB by the I-880 interstate freeway, as shown on Figure 1-2, a recent aerial photograph. Planned land uses are commercial and industrial for the portions of the OARB to be transferred to OBRA under the EDC and redeveloped under the Amended Reuse Plan. Potentially complete human exposure pathways, consistent with these land uses, have been identified and evaluated in the RAP. The RAP defines the risk-based remediation goals that will apply during and after redevelopment of OARB (for both the GDA and PDA) and establishes the recommended remedial actions for identified, and reasonably anticipated, locations where chemical releases have occurred that necessitate response when compared with the stated remedial action objectives and site-specific remediation goals. Investigation and remediation of many locations at OARB will be phased to coincide with planned infrastructure upgrades and redevelopment activities, as discussed below.

1.4 SITE HISTORY AND CURRENT CONDITIONS

The site use history and current conditions at the OARB are described in Sections 1.4.1 through 1.4.4.

1.4.1 Former Uses

Background information on site use history and setting is provided in Section 3. Much of the area encompassing the OARB, including the area west of current Maritime Street, was natural tidal marsh or shallow open water before 1916 (Kleinfelder, 1998a). Filling occurred in subsequent years to construct land for manufacturing buildings that predate the OARB and to create the remainder of OARB. As early as 1918, portions of the current OARB were in industrial use. The OARB served as a major Army cargo port and warehousing facility from 1941 until the OARB was officially closed for military purposes under the BRAC program on 30 September 1999 consistent with legislation passed by Congress in 1995 (IT, 2001a). Army activities to support the OARB's primary military mission as a distribution center included maintaining and fueling railroad locomotive engines and trucks, draining fluids from vehicles for overseas shipment, and repairing and servicing vehicles, equipment, and base facilities (IT, 2001a).

1.4.2 Prior Investigations

The Army has been conducting comprehensive site environmental investigations since approximately 1989. These investigations have been overseen by the DTSC, as the primary agency overseeing investigation and cleanup of the OARB, and the Regional Water Quality Control Board, San Francisco Bay Region ("RWQCB") as the agency overseeing the removal and closure of petroleum fuel tanks. The prior removal actions and remedial investigations already completed by others at OARB are summarized in Section 4, and an extensive list of reference documents is provided in Section 13.

1.4.3 Identified Chemicals of Concern

As of March 2002, the computerized database for the OARB contained over 204,000 records of analytical results of soil, water, and air samples collected primarily by the Army between 1989 and 2002. As summarized in Section 5, these existing data were evaluated to identify chemicals of concern ("COCs") found in soil and groundwater on the portions of the OARB property to be transferred to OBRA via the EDC.

1.4.4 Identified Environmental Issues

Chemical release areas at the OARB are shown on Figure 4-1 and were divided into RAP sites and RMP locations. RAP sites are shown in solid green or blue hatching on Figure 4-1. Identified RMP locations are shown in brown. These sites and locations are discussed in Section 4.

1.4.4.1 RAP Sites

RAP sites consist of seven identified chemical release areas that require remediation to protect human health and the environment. Effective cleanup of RAP sites are not anticipated to be cost-effectively implemented as part of redevelopment and must be started prior to redevelopment to prevent conflicts with land reuse. Residual contamination found at the RAP sites may not be sufficiently characterized or is not likely to be adequately remediated as part of activities performed during or after redevelopment. For example, greater amounts of time are potentially needed to implement active measures to reduce volatile organic compounds ("VOCs") in groundwater to concentrations less than applicable remediation goals at sites with VOC-impacted groundwater, such as Building 807, Buildings 808 and 823, and Building 99. Alternatively, if active measures are not selected as remedies to reduce VOC concentrations at these sites, engineering controls can be designed and incorporated into new building construction to mitigate the potential for a vapor intrusion exposure pathway. However, adequate time must still be allowed to incorporate the design of engineering controls in new building construction.

1.4.4.2 RMP Implementation Area

All of the OARB property to be transferred to OBRA via the EDC is included in the RMP Implementation Area. Within the RMP Implementation Area, RMP protocols will be implemented during and after remediation and redevelopment activities. The RMP Implementation Area includes numerous locations that involve documented or suspected small releases of petroleum hydrocarbons to soil. Petroleum releases have impacted groundwater to a minor extent at some of these locations. In response, routine groundwater monitoring is being conducted to fulfill closure requirements imposed by RWQCB. Petroleum-impacted areas are common at former industrial properties undergoing redevelopment (i.e., Brownfields) in the San Francisco Bay Area. Developers, contractors, and governmental agencies have found that these types of releases can be easily managed during new construction through application of an RMP.

The RMP (Appendix E) describes the health protective measures to be implemented, during and after redevelopment, for identified chemical release sites, land uses, and potential exposure pathways in the GDA and PDA. Institutional controls will obligate owners and tenants at the GDA and PDA to update information in the RMP based on conditions encountered or upon changes in land uses, environmental statutes, or chemical toxicity information. The RMP protocols will be implemented unless and until the need for such protocols are terminated on a location-specific or base-wide basis with the approval of the DTSC. Any applicable deed restrictions or notices are also included in the RMP.

The NCP at 40 CFR §300.430(a)(1)(iii)(B) states that "U.S. EPA expects to use engineering controls, such as containment, for waste that poses a relatively low long-term threat or where treatment is impracticable." Buildings, asphalt roadways, concrete pavement, imported clean soil, and other cover types existing and planned at the OARB adequately protect human health against direct contact with petroleum hydrocarbons and other COCs most frequently identified at RMP locations from review of available site use history and environmental data. The releases have generally affected a small quantity of soil and make the RMP locations at GDA and PDA relatively straightforward to address as they are encountered prior to, during, or after redevelopment. For example, as construction proceeds, properly trained workers can be mobilized to excavate identified areas of contaminated soil for subsequent reuse or disposal at an off-site, permitted waste management facility.

OBRA proposes to address RMP implementation requirements in a phased manner at the GDA and PDA that is consistent with the schedule for redevelopment. In the event that the nature and extent of the releases at RMP locations are found to differ significantly from the conditions described in this RAP, the appropriateness of response measures contained in the RMP (Appendix E) will be re-evaluated for such specific RMP locations. The RMP also specifies the situations under which response measures will be re-evaluated in consultation with DTSC.

1.4.4.3 Interim Use Sites

Brief descriptions and site location maps of the interim use sites are provided in Appendix D. Analytical data from investigations conducted at or near these interim use sites are available in the electronic database (Appendix A), and in the Phase II Investigation reports prepared by the Army (IT, 2002a) and OBRA (EKI, 2002). The results of Phase II Investigations conducted at or near these interim use sites are briefly summarized in Appendix D where potentially relevant.

1.5 APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS

Applicable or Relevant and Appropriate Requirements ("ARARs") and To-Be-Considered materials ("TBCs") are evaluated in Section 6. The release or threatened release of a hazardous substance into the environment provides the basis for cleanups under Chapter 6.8 of the California HSC in California and federal NCP requirements.

Chemical-, location-, and action-specific ARARs that pertain to identified RAP sites and RMP locations at the OARB are evaluated in Section 6, and a detailed evaluation is presented in Table 6-1.

1.5.1 Federal ARARs and TBCs

The Clean Water Act ("CWA"), Toxic Substances Control Act ("TSCA"), Resource Conservation and Recovery Act ("RCRA"), and the Clean Air Act ("CAA") are some of the federal environmental laws with requirements that are frequently applicable or relevant and appropriate to site remediation activities. In addition, Section 6 also includes an evaluation of the California Toxics Rule, a regulation identifying water quality criteria that was adopted by the SWRCB, as well as other ARARs and TBCs.

1.5.2 State ARARs and TBCs

Some of the state ARARs and TBCs identified in Section 6 include the RWQCB Basin Plan, risk-based screening levels ("RBSLs"), applicable SWRCB Resolutions, and applicable sections of the California HSC and California Code of Regulations ("CCR").

1.5.3 Oakland Urban Land Redevelopment Program

In addition to the numerous federal and state statutes and regulatory requirements discussed in Section 6, the remediation and reuse of the OARB property by the City will be implemented under the Oakland Urban Land Redevelopment Program ("ULR") (Oakland, 2000). The ULR is the result of a collaborative effort between the City of Oakland and the principal agencies that enforce environmental regulations. Participating agencies included the DTSC, RWQCB, United States Environmental Protection Agency ("U.S. EPA"), and Alameda County Department of Environmental Health. However, for the purposes of the site specific risk analysis in this RAP, DTSC and OBRA modified the human health exposure parameters to calculate remediation goals for the OARB.

The Oakland ULR program is a three-tiered risk-based corrective action process. Tiers 1 and 2 consist of numerical cleanup levels in "look-up" tables that are applicable to properties that involve particular land uses, types of chemical releases, and geologic and hydrogeologic conditions. Tier 3 of the ULR program provides a methodology for calculating site-specific remediation goals that incorporate human health exposure parameters that are specific to Oakland. The City sought public comment on the ULR including elements related to acceptable residual risk. The ULR therefore provides important information on community acceptance of residual risk that can be considered in evaluating various alternative cleanup scenarios.

1.6 STATEMENT OF REMEDIAL ACTION OBJECTIVES

To attain the NCP goals of implementing remedial actions that protect human health and the environment, maintain protection over time, and minimize untreated waste, the remedial action objectives ("RAOs") for soil and groundwater on the OARB property transferred to OBRA by EDC (i.e., "OARB locations") are:

- Establish media-specific individual remediation goals that correspond to a Hazard Index ("HI") of 1 for each non-carcinogenic COC identified at the OARB. Remedial actions implemented at each RAP site or RMP location will be designed to meet individual non-carcinogenic COC remediation goals as established in Section 7.3, unless the cumulative non-carcinogenic risk goal as defined in this RAP can be met by alternative concentration limits demonstrated for a specific RAP site or RMP location to the satisfaction of DTSC. When multiple non-carcinogenic COCs are identified at a specific RAP site or RMP location, the cumulative non-carcinogenic target hazard index can be met by determining aggregate non-carcinogenic risk using the protocols in Section 7.5. Once remediation activities for a RAP site or RMP location have been completed pursuant to the RAP and RMP, confirmation samples will be collected to verify the cumulative non-carcinogenic hazard index of COCs (associated with the potentially complete exposure pathways defined in this RAP) remaining in soil and groundwater at each RAP site or RMP location will not exceed a cumulative HI of 1. The individual remediation goals for non-carcinogens in Table 7-11 represent the maximum allowable concentrations for the respective COCs. However, these remediation goals can be adjusted downward, as needed, if the total HI exceeds 1.

- Establish media-specific individual remediation goals that correspond to a 10^{-6} incremental lifetime cancer risk for each potential carcinogenic COC identified at the OARB. Remedial actions implemented at each RAP site or RMP location will be designed to meet individual carcinogenic COC remediation goals as established in Section 7.3, unless the cumulative carcinogenic risk goal as defined in this RAP can be met by alternative concentration limits demonstrated for a specific RAP site or RMP location to the satisfaction of DTSC. When multiple carcinogenic COCs are identified at a specific RAP site or RMP location, the cumulative carcinogen target risk level can be met by determining aggregate carcinogenic risk using protocols and equations provided in Section 7.5. Once remediation activities for a RAP site or RMP location have been completed pursuant to the RAP and RMP, confirmation samples will be collected to verify the cumulative carcinogenic risk of COCs (associated with the potentially complete exposure pathways defined in this RAP) remaining in soil and groundwater at each RAP site or RMP location will not exceed a cumulative, incremental lifetime human health carcinogen target risk level of 10^{-5}. As discussed in Section 7.3.3.2, the cumulative, incremental lifetime carcinogen target risk level of 10^{-5} is determined to be appropriate for the OARB after considering the applicability of the full risk range acceptable under the NCP and the cumulative carcinogenic risk goal of 10^{-6} as used by DTSC as the "point of departure" for evaluating remedial alternatives at sites in California under Chapter 6.8 of the HSC. The individual remediation goals in Table 7-11 represent the maximum allowable concentrations for the respective COCs. These remediation goals will not be increased to allocate amongst the residual COCs to meet the overarching cumulative risk of 10^{-5}. However, these remediation goals can be adjusted downward, as needed, if the total cancer risk level exceeds 10^{-5}.

- Establish a remediation goal for lead that does not exceed a blood lead concentration greater than 10 micrograms per deciliter ("µg/dl") at the 99th percentile in potentially exposed individuals resulting from the total exposure to lead at OARB locations and to naturally occurring lead in the environment (e.g., air, food, water) as calculated using the DTSC Lead Spread 7.0 computer model or a more stringent site-specific lead goal determined appropriate for OARB.

- Remove, or remove and treat, source material (i.e., principal threat waste) that poses significant human health or environmental threats or is prone to continued leaching of COCs to groundwater.

Action-specific, base-wide RAOs for soil and groundwater at RAP sites and RMP locations predicated on the above aims are as follows:

Soil RAOs:

- Maintain existing conditions at the OARB to prevent direct contact with known or potentially impacted soil prior to implementation of remedial actions or redevelopment.

- Specifically for the ORP / Building 1 area, remove, or remove and treat, tarry residue at ORP / Building 1 area to eliminate hazards associated with this source material and to allow planned land uses consistent with the Amended Reuse Plan.

- Remove or treat impacted soil that interferes with planned land uses, or is encountered during redevelopment or through post-redevelopment activities, or as otherwise necessary to achieve site-specific, soil remediation goals designated in the RAP.

- Contain impacted soil that will not unreasonably interfere with planned land uses by maintaining existing cover or constructing new cover.

Groundwater RAOs:

- Implement institutional controls, alone or in combination with site-specific engineering controls as part of all selected remedies, to prevent incidental ingestion or dermal contact with impacted groundwater under existing and planned land uses consistent with the Amended Reuse Plan.

- Treat VOC-impacted groundwater that interferes with planned land uses or as otherwise needed to achieve site-specific, groundwater remediation goals, or apply engineering controls to new structures to allow planned redevelopment or as otherwise necessary to reduce potential exposure posed by vapor intrusion to the target risk levels stated above.

- Prevent further significant increases of concentrations of metals and other non-volatile COCs in groundwater.

The site-specific numerical remediation levels for COCs in soil and groundwater determined to be consistent with these RAOs are developed in Section 7.3 and are listed in Table 7-11.

1.7 IDENTIFICATION OF REMEDIAL ACTION ALTERNATIVES

Identifying and screening potentially suitable technologies is the initial step in assembling appropriate remedies that achieve the RAOs established in Section 7, comply with ARARs, and satisfy other evaluation criteria established by U.S. EPA and the State of California. Technologies that pass the screening process are developed into remedial alternatives. Section 8 describes the identification and screening of technologies. The remedial alternatives are screened, and then undergo detailed analysis. Section 9 summarizes the development and screening of remedial action alternatives. Table 9-3 summarizes the remedial action alternatives for RAP sites and RMP locations that were retained for detailed evaluation.

1.8 RECOMMENDED REMEDIAL ACTIONS

The results of the detailed analysis determine the remedial alternatives that are recommended for implementation. Section 10 presents the detailed analysis of alternatives against NCP and state criteria and ends with a summary of recommended remedial actions at identified RAP sites and RMP locations and estimated remediation costs (Table 10-32). The implementation schedule is discussed in Section 11 for the recommended remedial actions, including implementation of the RMP as phased redevelopment occurs.

1.9 DECLARATION / STATUTORY DETERMINATION

The selected remedies for the RAP sites and RMP locations at OARB are intended to be protective of human health and the environment. They comply with federal and state requirements that are legally applicable or relevant and appropriate to the remedial actions and they are cost effective.

Because the selected remedies may allow hazardous substances to remain on-site above levels that allow for unrestricted use, a review of selected and implemented remedies will be conducted at five years after remedial action begins to ensure that the selected remedies provide adequate protection of human health and the environment.

The RAP and RMP shall be effective and enforceable only when the Army completes the conveyance of the areas covered in this RAP to OBRA.

Aliza Gallo

9/27/2002

Aliza Gallo
Executive Director
Oakland Base Reuse Authority

Date

Anthony J Landis

9-27-02

Anthony Landis, P.E.
Chief, Northern California Operations
Office of Military Facilities
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Date

2

2. INTRODUCTION

This RAP identifies and evaluates potential remedial alternatives for certain identified and to-be-identified sites of environmental concern at the OARB in Oakland, California. OARB is scheduled to be transferred to the OBRA by the Army via an EDC prior to the completion of all required environmental remediation. This early transfer requires that both the State of California and the Army find that all required remediation will be undertaken after transfer ("Finding of Suitability for Early Transfer" or "FOSET"). This requirement is met when the Governor determines that there is adequate assurance that all remedial actions necessary will be completed and that public health and the environment will be protected in the interim.

Recommended remedial actions in this RAP are based upon evaluation of selection criteria contained in Chapter 6.8 of the HSC including as referenced therein, the NCP, set forth in Part 300, Title 40 of the CFR. Upon approval, this RAP will set forth the remediation program which must be implemented at OARB to satisfy applicable State requirements.

2.1 INTENDED REUSE OF OARB

The OARB consists of approximately 425 acres of land. The Army is proposing to transfer approximately 366 acres of this land (including approximately 56 acres of offshore submerged land) to OBRA under the EDC provisions of the BRAC Act[4]. The Army Reserve is currently in possession of 26 of the remaining acres. Former BRAC Parcel 1[5] or "Spit" totaling approximately 13 acres of uplands will be transferred to the DOI on behalf of the EBRPD through a PBC, which is shown in pink on Figures 1-2 and 4-1. An additional area of approximately 6 acres of submerged land, including marine sediments at Outfall 4, are also defined to be part of the "Spit" that is not being transferred via the EDC. EBRPD will manage the land provided to the agency

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[4] The OARB property being transferred to OBRA excludes approximately 20 acres of OARB property, primarily located beneath I-880, which was transferred from the Federal Highway Administration to Caltrans in March of 2002. Litigation regarding this transfer is ongoing; however, this Caltrans property is not currently being planned for transfer from the Army to OBRA and, thus, is not subject to this RAP.

[5] As discussed in Section 4.1, BRAC parcels and OUs are terminology that was employed by the Army in administrating its environmental program at the OARB. Such terminology is not used in this RAP/RMP to describe known or potential chemical release sites. Chemical release sites are referenced in the RAP/RMP by the designations assigned on Army maps and facility records to the tank, structure or building that was associated with, or nearby, a known or potential release.

by the Army as open space for public recreation and habitat. The Army Reserve is separately pursuing plans to sell its parcels and relocate its activities elsewhere in the San Francisco Bay Area.

The *Redevelopment Environmental Impact Report* ("EIR"), prepared on behalf of the ORA and OBRA (collectively referred to herein as "City"), indicates that approximately 133 acres of the OARB will be redeveloped with a variety of commercial and industrial uses as part of the GDA. Approximately 233 acres (including 56 acres of submerged lands) will be employed for maritime, rail, and other port activities as part of the PDA. Details of the redevelopment strategy are presented in OBRA's *Amended Draft Final Reuse Plan for the Oakland Army Base (OARB)*, dated 23 July 2001 ("Amended Reuse Plan"). The Port of Oakland's specific land use objectives are presented in its *Strategic Plan Summary, Fiscal Years 2002-2006*, dated June 2001.

Redevelopment of the OARB is anticipated to begin at vacant and underutilized parcels shortly after conveyance. To finance a portion of redevelopment costs, existing rented structures are planned to remain under lease for approximately three years after conveyance. These existing interim uses primarily include warehouse, commercial and maritime activities. The Homeless Collaborative ("HC") also operates a large food bank warehousing facility, job training and counseling facilities, and transitional housing. The Oakland Military Institute College Preparatory Academy ("OMI"), a charter middle school, operates in temporary classrooms and an existing administration building. The interim site uses identified and discussed in Appendix D may continue to occupy the sites and buildings for five years post-transfer upon DTSC's issuance of waivers for such specified sensitive reuses. The Amended Reuse Plan anticipates that these interim HC and OMI uses will be eventually relocated as part of the redevelopment program for the OARB. Redevelopment and site remedial activities will not be delayed as a result of the existing leases.

2.2 APPROACH TO ENVIRONMENTAL RESTORATION OF OARB

Congress passed legislation in 1995 that designated closure of the OARB for military purposes under the BRAC program. OBRA was created to assist with the closure process as the LRA. OBRA is managing the OARB and its assets during the time between base closure and transfer. As the LRA, OBRA prepared the Amended Reuse Plan and will accept approximately 366 acres of the OARB from the Army. OBRA will subsequently convey this land to ORA, which will manage this property on behalf of the City of Oakland and will be responsible for implementing the Amended Reuse Plan. ORA, as successor-in-interest to OBRA, will assume responsibility from the Army for addressing specifically identified environmental matters that remain at the OARB at the GDA after transfer. With prior approval by DTSC, Port of Oakland may complete some remedial actions on the PDA. Excluded environmental issues are identified in Section 2.4.

DTSC is the primary state agency overseeing investigation and cleanup of the OARB. Representatives of OBRA have held many discussions, meetings, and negotiations with DTSC and the Army regarding the remediation process to be followed after transfer of the OARB is completed. These efforts have culminated in a proposal that recognizes the planned future commercial and industrial reuses of the OARB and provides for risk-based remediation of soil and groundwater for the portion of the OARB that will be transferred via an EDC to OBRA and, ultimately, to ORA. Implementation requirements for this RAP will be formalized in a Consent Agreement between DTSC, OBRA, and ORA. With certain exceptions discussed in Section 2.4, the Consent Agreement prescribes a binding legal process by which all required remedial actions will be completed. A key element of the Consent Agreement is the completion of the selected remedies in this RAP and implementation of the RMP, which is Appendix E to this RAP.

The RAP identifies institutional controls as an integral component of all remedial actions considered for the OARB. These institutional controls are anticipated to consist of land and groundwater use restrictions and requirements to comply with the RMP. The City has prepared the RMP for two purposes. The first purpose of the RMP is to implement a presumptive-style remedy for a suite of sites with standard contaminant profiles and site conditions. The second purpose of the RMP is to establish site identification and health protective protocols to be implemented at RMP locations as these locations are encountered or identified during redevelopment. DTSC requires that institutional controls be established in a land use covenant signed by DTSC and the City. The procedure for recording the land use covenant is set forth in the Consent Agreement. Upon execution of the land use covenant, the RMP would also become an appendix to the land use covenant.

The RAP defines the risk-based remediation goals that apply during and after redevelopment of the OARB. The RAP also establishes the remedial actions for identified, and reasonably anticipated, locations where chemical releases have occurred and require response when compared with the stated remedial action objectives and site-specific remediation goals for soil and groundwater. Investigation and remediation of many locations at the OARB will be phased to coincide with planned infrastructure upgrades and redevelopment activities.

The approach to remediation presented in the RAP / RMP for the OARB is commonly employed to facilitate cleanup and redevelopment of former commercial and industrial properties. Such sites are often referred to as "Brownfields." DTSC and other state and local agencies have approved many Brownfields projects in the San Francisco Bay Area for commercial/industrial properties that contain residual concentrations of hazardous substances and petroleum constituents. Brownfields projects are also facilitated by the City of Oakland's ULR program and its associated guidance documents and permit tracking system.

2.3 PURPOSE OF RAP / RMP

The purpose of the RAP / RMP is to identify remedies, from among a suite of remedial action alternatives, that are protective of human health and the environment, are cost-effective, and allow reuse of the OARB as intended under the Amended Reuse Plan. The understanding of environmental conditions, establishment of remediation goals, and selection of remedial actions are accomplished in the RAP.

The RMP can be generally described as an operation and maintenance plan, which is intended to ensure that implemented remedies provide protection of human health and the environment, during and after redevelopment. The RMP prescribes, among other things, the measures that will be implemented in the future to ensure that human health and the environment are adequately protected.

The RAP / RMP has been prepared consistent with requirements for preparing a RAP under Section 25356.1 of Chapter 6.8 of the California HSC, including requirements related to the federal NCP. The federal regulations were promulgated under Section 105 of the Comprehensive Environmental Response, Compensation, and Liability Act ("CERCLA"), as amended by the Superfund Amendments and Reauthorization Act ("SARA") of 1986. CERCLA was established in 1980 to identify sites where hazardous substances have been released to the environment, to assess the risk of those releases, and to ensure that the parties responsible for the releases clean up the sites. CERCLA and SARA are often collectively referred to as "Superfund."

It should be recognized that CERCLA governs only the cleanup of a release or threatened release of a "hazardous substance" into the environment, which incorporates substances, elements, compounds, solutions, or mixtures regulated under RCRA, CWA, CAA, or TSCA. The definition of hazardous substances excludes petroleum hydrocarbons. The NCP at Title 40 of the CFR, Part 300.5 states that the term hazardous substances:

> ...does not include petroleum, including crude oil or any fraction thereof which is not otherwise specifically listed or designated as a hazardous

> substance in the first sentence of this paragraph, and the term does not include natural gas, natural gas liquids, liquefied natural gas, or synthetic gas usable for fuel (or mixtures of natural gas and such synthetic gas).

DTSC supervises remediation of hazardous substance and hazardous waste constituent release sites at the OARB. The RWQCB generally oversees actions necessary to protect the waters of the State of California, including the removal and closure of petroleum fuel tanks at the OARB.[6]

For purposes of this RAP / RMP, hazardous substance and petroleum releases are collectively referred to as "chemical release sites." Petroleum releases have been included in the RAP / RMP for completeness and to facilitate an integrated approach toward environmental restoration of the OARB. To maintain continuity with the existing regulatory framework, it is anticipated that DTSC and RWQCB will oversee implementation of the RAP / RMP for hazardous substance and petroleum release sites, respectively.

2.4 ENVIRONMENTAL ISSUES NOT INCLUDED IN RAP / RMP

Under the ESCA to be signed between the Army and OBRA, the Army retains responsibility for cleanup of radiological materials, chemical and biologic warfare agents, and unexploded ordnance, if any, that may be present at the OARB. None of these materials are known or suspected to be present based on site investigation activities that have occurred over the past six years.

The Army also retains responsibility for remediation of the former BRAC Parcel 1 and associated submerged marine sediments at Outfall 4 in the Oakland Outer Harbor. It is anticipated that sediment remediation requirements will be addressed by the Army in connection with the related remediation of the uplands of the 15-acre parcel (also known as the "Spit"). The Army will continue to own the "Spit" and it is anticipated that the Army will transfer the "Spit" via a PBC to DOI and the EBRPD under a "Finding of Suitability for Transfer" ("FOST") after all required remediation has been completed.

Other than these environmental issues for which the Army retains responsibility, necessary remediation, if any, of OARB property that is not being transferred to OBRA

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[6] RWQCB is a branch of Cal / EPA. RWQCB's overall mission is to protect the beneficial use of surface water and groundwater within the San Francisco Bay Area.

via the EDC is not considered in this RAP / RMP[7]. The following property is not addressed in this RAP / RMP:

- Former BRAC Parcel 1[8] or "Spit" totaling approximately 12.8 acres of uplands to be transferred to the DOI on behalf of the EBRPD through a PBC, which is shown in pink on Figures 1-2 and 4-1. An additional area of approximately 6.4 acres of submerged land, including marine sediments at Outfall 4, are also defined to be part of the "Spit" that is not being transferred via the EDC.

- Army Reserve parcels totaling approximately 26 acres, which comprised former Army BRAC Parcels 6, 7, and 18, and portions of former BRAC Parcels 19 and 21, shown in yellow on Figure 4-1.

- Any property that is not being transferred via the EDC.

OARB properties not transferred will continue to be owned and managed by the Army and United States and are outside of the scope of the Consent Agreement and this RAP / RMP.

[7] Off-site property adjacent to the EDC area that may be contaminated from Army activities is excluded from the RAP / RMP except for groundwater contamination caused exclusively by Army activities that occurred on the EDC area. Off-site areas excluded from the EDC area and the RAP / RMP include, for example, former Parcel 1 and off-site pesticide releases described in Section 4.4.3.6 of the RAP.

[8] As discussed in Section 4.1, BRAC parcels and OUs are terminology that was employed by the Army in administrating its environmental program at the OARB. Such terminology is not used in this RAP/RMP to describe chemical release sites. Chemical release sites are referenced in the RAP/RMP by the designations assigned on Army maps and facility records to the tank, structure or building that was involved with a given release.

3

3. SITE BACKGROUND

This section provides background information on the OARB property. Included in this section is a synopsis of the regional setting, and descriptions of the use history, site features, geology, and hydrogeology of the OARB.

3.1 REGIONAL SETTING

Land surrounding the OARB is zoned Industrial (M) by the City of Oakland. The OARB itself is zoned Heavy Industrial (M-40). Port of Oakland harbor facilities lie west and south of the OARB (Figure 1-2). Port of Oakland harbor facilities consist of railroads and marine terminals with large waterfront cranes for loading and unloading cargo containers from ships. Cargo containers are stacked in the yards of the marine terminals and large transport trucks are common on Maritime Street and Port of Oakland roadways either actively moving cargo or waiting in queues to enter the terminals. The East Bay Municipal Utility District ("EBMUD") wastewater treatment plant, railroads, and the elevated Interstate I-880 freeway border the eastern side of the OARB. North of the OARB is the Interstate I-80 freeway and touchdown of the Bay Bridge. The nearest off-site residential land use is located approximately 1,000 feet southeast of the OARB and is entirely separated from the OARB by the I-880 freeway, as shown on Figure 1-2, which is a recent aerial photograph.

3.2 OARB USE HISTORY

Much of the area encompassing the OARB was natural tidal marsh or shallow open water before 1916 (Kleinfelder, 1998a). Prior to the Army's occupancy of the OARB in January 1941, portions of the property were partially filled with dredge spoils placed by the Army Corps of Engineers ("ACE"), the City, and subsequently the Port of Oakland (ACE, undated; City of Oakland, 1918; Minor Woodruff, 2000). During 1941, the ACE and the Army (OARB was referred to at the time as the S.F. Port of Embarkation) placed over 6.5 million cubic yards ("cy") of dredged sand and imported soil to create the remainder of the land area (Army Port Contractors, 1941; Army Port Contractors, 1942; Bechtel-McCone-Parsons Corporation, 1941; Labarre, R.V., 1941; Rogers, David and Sands Figuers, 1991).

According to the review of historical documents conducted for the Army by IT (2000j), industrial activity first took place in the area of the OARB in approximately 1918, prior to Army ownership, when Building 99 was constructed for ship manufacturing. Metalworking operations also reportedly occurred in this building from the 1920s through the 1930s. An oil reclaiming plant ("ORP") began operating on or about 1924 (IT, 2000j). The ORP was situated approximately 400 feet northeast of Building 99. Recycling processes at the ORP may have involved adding concentrated sulfuric acid to waste oil that was followed by distillation to recover useful oil fractions (IT, 2001i).

The Army acquired the property in 1941 for the OARB. The ORP was demolished and Building 99 was converted for use by the Army as a vehicle and electrical maintenance shop (IT, 2000i). The OARB served as a major Army cargo port and warehousing facility from 1941 until the OARB was officially closed for military purposes under the BRAC program on 30 September 1999 (IT, 2001a). Activities that were conducted by the Army to support the OARB's primary military mission as a distribution center included maintaining and fueling railroad locomotive engines and trucks that transported cargo, draining fluids from vehicles for overseas shipment, and repairing and servicing vehicles, equipment, and base facilities (IT, 2001a).

OBRA and the Port of Oakland currently manage an interim leasing program at the OARB. Interim leases expire at various future dates, but none currently extend past mid-June 2003 according to the EIR. Tenants occupying the portion of the OARB west of Maritime Street during the interim leasing period are primarily involved in railroad and marine transportation services, such as berthing; and loading, unloading, storing, and transporting of cargo. Interim uses east of Maritime Street include transportation, commercial, light industrial (e.g., woodworking, mobile recycling), and community services. Certain community services including the Head Start program, the Oakland Military Institute College Preparatory Academy,[9] a seasonal, cold-weather homeless shelter, and a licensed residential drug and alcohol treatment facility for the homeless ("interim use sites") are discussed in Appendix D. All interim uses at the four buildings and associated areas identified in Appendix D may continue to occupy the sites and buildings for five years post-transfer upon DTSC's issuance of waivers for such specified sensitive reuses. No existing residences present on the OARB will be occupied in the future under the Amended Reuse Plan.

[9] The EIR indicates that the school currently has approximately 150 7th grade students, but enrollment is expected to increase as discussed in Appendix D.

3.3 OARB SITE FEATURES

Buildings, railroads, roadways, and paved parking or storage areas dominate the OARB. As a consequence, no significant ecological habitats exist in the upland areas of the OARB being transferred to OBRA via the EDC. The little vegetation that is present in these upland areas consists of exotic and landscaped plant species. Two small, low quality wetlands are located off-site, adjacent to the OARB. The wetlands are situated between railroad tracks east of Building 991. One wetland is 0.34 acre and the other is 0.15 acre. The only undeveloped portion of the OARB is the approximately, referred to as the "Spit". The "Spit" will ultimately be transferred via PBC with a FOST to DOI/EBRPD (Figure 1-2) and is not included in this RAP.

3.4 OARB GEOLOGY

Much of the area encompassing the OARB, including the area west of current Maritime Street, was natural tidal marsh before 1916 (Kleinfelder, 1998a). Filling occurred in subsequent years to construct land for manufacturing buildings that predate the OARB and to create the OARB. According to IT (2001a), gravelly sand fill, which was imported from quarries near Lake Temescal and Oak Knoll Naval Hospital, is encountered below buildings and paved surfaces on the OARB and extends to a depth of approximately 5 feet below ground surface ("bgs"). A second fill layer exists between approximately 5 to 15 feet bgs. This second layer of fill consists of fine-grained sand that was hydraulically dredged from San Francisco Bay (IT, 1998a).

3.5 OARB HYDROGEOLOGY

Groundwater is generally encountered between 5 to 7 feet bgs in the fill layers, which comprise the shallow water-bearing zone at the OARB (IT, 2000m). Beginning at approximately 15 feet bgs, a sequence of clay on the order of 10 feet thick, referred to as Young Bay Mud, underlies the shallow water-bearing zone. The Young Bay Mud is not very permeable. ACE and Port of Oakland (1998) stated in the EIR for proposed dredging of Oakland Harbor that the Young Bay Mud is an aquitard with a low permeability of 1×10^{-7} cm/s. The Young Bay Mud restricts downward movement of groundwater to the next deeper water-bearing zone that is located at a depth of approximately 25 feet bgs. This deeper water-bearing zone is referred to as the Merritt Sand, which is the uppermost member of the San Antonio Formation (Kleinfelder, 1998a). The OARB lies in the East Bay Plain groundwater basin.

3.5.1 Groundwater Quality

Groundwater in both the shallow water-bearing zone and Merritt Sand is of poor quality due to the proximity to San Francisco Bay. Brackish conditions beneath the OARB and other near shore areas of Alameda County are due largely to unmanaged pumping of groundwater from the late 1800s through the 1920s that depleted subsurface freshwater reserves and caused significant saltwater intrusion (Figuers, 1998). Analysis of water samples collected from the five monitoring wells completed in the Merritt Sand beneath the OARB finds that groundwater beneath the OARB in the Merritt Sand has total dissolved solids ("TDS") concentrations greater than 10,000 mg/L (IT, 2000m). U.S. EPA (1986) considers groundwater that has a TDS concentration over 10,000 mg/L to be unsuitable for potential drinking water supply and of limited beneficial use.

Saltwater has also significantly affected the water quality of the shallow water-bearing zone in fill. In a study performed between 1997 and 1999, TDS concentrations were measured in 43 monitoring wells completed into the shallow water-bearing zone at the OARB. The TDS concentrations in these wells ranged from 343 to 21,200 mg/L, with the mean TDS concentration calculated to be 4,600 mg/L for all wells measured during this study (IT, 2000m). Kleinfelder (1998a) previously concluded that TDS variability in the shallow water-bearing zone is due to localized infiltration of surface water (e.g., landscape irrigation, leaks in water lines, exfiltration from storm drains and sanitary sewers) that dilutes the otherwise brackish groundwater in the vicinity of certain monitoring wells. RWQCB agreed with this conclusion and stated in its letter, dated 9 December 1998, that freshwater in the shallow water-bearing zone is "most likely due to artificial or man made inputs." RWQCB also commented in the letter that "TDS levels of the shallow fill aquifer at OARB will likely increase when the artificial inputs to the system are reduced."

TDS concentrations in the shallow water-bearing zone and Merritt Sand make the groundwater unsuitable for potable use. For TDS in drinking water, the State of California Department of Health Services ("DHS") has promulgated a recommended secondary Maximum Contaminant Level ("MCL") of 500 mg/L and a short-term secondary MCL of 1,500 mg/L promulgated under Section 64449 of Title 22 of the Code of California Regulations ("CCR"). Although DHS recommends that TDS concentrations in drinking water be below 500 mg/L, TDS concentrations as high as 1,000 mg/L are acceptable if DHS considers it "neither reasonable nor feasible to provide more suitable waters" (22 CCR §64449). Excursions to the short-term level of 1,500 mg/L are acceptable only if on a temporary basis pending construction of new treatment facilities or development of acceptable new water sources.

RWQCB (1999b) recognizes the poor quality of groundwater near the OARB and has proposed a formal determination or de-designation that groundwater along the Oakland shoreline, including the OARB, cannot be used for drinking water supply. RWQCB (2000) bases the proposed de-designation on the fact that groundwater is brackish and meets the exemption criteria under State Water Resources Control Board ("SWRCB") Resolution No. 88-63 (SWRCB, 1988). Under this resolution, SWRCB considers water with a TDS greater than 3,000 mg/L to "be unsuitable, or potentially unsuitable, for municipal or domestic water supply." RWQCB (1998) has stated that the exemption criteria contained in Resolution No. 88-63 applies to the shallow water-bearing zone at the OARB. SWRCB has not yet approved the de-designation proposed by RWQCB.

3.5.2 Potential for Contaminant Migration to San Francisco Bay Via Groundwater

The land surface at the OARB sloped to the west or northwest before filling took place and the original flow of groundwater probably followed these contours. Seawalls constructed along portions of the Port of Oakland harbor facilities, west of the OARB, affects movement of groundwater in the shallow water-bearing zone to San Francisco Bay. Where present, the seawall extends down to a depth of approximately 45 feet bgs and is constructed at the shoreline of the maritime terminals. The seawall penetrates the shallow water-bearing zone, the Young Bay Mud, and terminates in the Merritt Sand, thereby serving as a barrier to lateral groundwater flow in the shallow water-bearing zone. Current groundwater flow is complicated by the presence of the seawall and other manmade features, such as the higher permeability sand or gravel bedding that surrounds storm drains, which may also influence groundwater movement. Studies performed on behalf of the Army have demonstrated that groundwater elevations in the shallow water-bearing zone and Merritt Sand within 600 feet of the shoreline are tidally influenced. However, Kleinfelder (1998a) states that these tidal influences are likely associated with pressure responses in the shallow water-bearing zone and Merritt Sand rather than actual exchange of water with San Francisco Bay.

Groundwater data collected to date, including the Phase II Investigation data described in Section 4.4.4.10, indicate that COC impacts to shallow groundwater are confined primarily to identified RAP groundwater sites entirely within the boundary of the OARB and that COCs are not migrating in groundwater from these RAP sites to San Francisco Bay because the groundwater velocity is low compared with the rate of sorption and degradation mechanisms (Kleinfelder, 1998a). In other words, the VOC distributions in the shallow water-bearing zone at eastern end of Building 807 appear to be at steady state.

Although the movement of contaminants in groundwater through the shallow water-bearing zone appears restricted and subject to natural attenuation, it is possible that groundwater migrates to San Francisco Bay through the sand or gravel bedding that surrounds storm drains or through storm drain piping. Storm drain piping at the OARB is documented to have breaks and cracks. Storm drain piping is often situated in the saturated zone, and groundwater may enter the cracked or otherwise breached storm drain piping. However, groundwater that may enter the storm drains in most areas of the OARB is not likely to be contaminated, and contaminated areas near storm drains are subject to remedial actions discussed in subsequent section of this RAP.

4. OVERVIEW OF COMPLETED INVESTIGATIONS AND REMEDIAL ACTIVITIES

The use history and descriptions of the nature and extent of chemical impacts to soil and groundwater, if any, for RAP sites and RMP locations are based upon the results of record reviews, numerous studies, sampling efforts, and remedial activities at the OARB conducted primarily on behalf of the Army.

4.1 ARMY ENVIRONMENTAL PROGRAM

In 1995, pursuant to the Defense Base Closure and Realignment Act of 1990, Public Law 101-510 (10 U.S.C. Section 2687 note, as amended), the OARB was designated for closure. The Army's approach for completing environmental restoration at the OARB necessary to protect human health and the environment is outlined in the *Base Realignment and Closure Cleanup Plan* ("BCP"), dated July 1996. The plan divided the OARB into 26 areas, which were referred to as BRAC parcels. The Army eventually further organized the BRAC parcels into seven OUs for purposes of consolidating investigative and remedial actions at the OARB.[10]

The Army documented its investigations and remedial actions by the parcel and OU nomenclature. Table 4-1 provides a cross reference of sites of environmental concern identified in the RAP with the corresponding former parcel and OU designations used by the Army. These parcels and OUs have no current significance for the GDA or the PDA as the corresponding property boundaries or subdivisions were not surveyed or recorded, and they do not correspond to any reuse plan or program. Accordingly, chemical release sites at the OARB are referenced herein by the designations assigned on Army maps and in facility records to the specific tank, structure, or building that was potentially involved with a given release or present nearby.

Although cleanup efforts by the Army began in 1989, the BCP enabled a more comprehensive approach toward remediation of the OARB (IT, 2001a). The Army subsequently completed an Environmental Baseline Survey ("EBS"); (Foster Wheeler Environmental Corporation ("Foster Wheeler"), 1996a) and performed a Preliminary Assessment/Site Inspection ("PA/SI") (Kleinfelder, 1998b). These efforts involved

[10]The Army established a total of seven OUs even though only six of these OUs (i.e., OU1, OU2, OU3, OU4, OU5, and OU7) were employed to organize BRAC parcels. OU5 was designated for FOST parcels, of which none were approved. OU6 was reserved for future use and no BRAC parcels were ever placed in this OU.

conducting inspections, interviewing personnel who handled chemicals and hazardous materials, reviewing permits and records, examining aerial photographs, and studying geological and historical reports that pertain to the OARB. Soil, groundwater, and soil gas were tested as part of the PA/SI to identify sites at the OARB that required additional investigation and possible remedial action.

4.2 ARMY INVESTIGATIONS AND REMEDIAL ACTIVITIES

In response to the findings of the EBS and PA/SI, the Army conducted remedial investigations ("RIs") of the OARB. The RI results are summarized in several draft reports organized by the OUs defined by the Army (Harding ESE, 2001; IT, 2001b, 2001f, 2000a, 2000f, 2000i, 2000l, 1999). In addition to investigations that were performed as part of the RI, the Army conducted the following additional studies:

- Performed hydrogeologic evaluation (Kleinfelder, 1998a) and assessed groundwater quality at the OARB (IT, 2000m).

- Conducted additional soil, groundwater, and air sampling at the former ORP / Building 1 area (IT, 2002c).

- Surveyed buildings for lead-based paint ("LBP") and asbestos-containing material ("ACM"); (ACE, 1999a, 1997a).

- Investigated environmental conditions of storm drains and sanitary sewers at the OARB and prepared a draft report (ICF Kaiser Engineers, 1999a).

- Evaluated potential remedial actions for contaminated sites by completing draft feasibility studies (IT, 2001i, 2000d).

- Conducted further review of historic records (Foster Wheeler, 2000; IT, 2000j).

- Sampled monitoring wells on a quarterly basis (IT, 2002g).

The Army also performed remedial activities at many locations on the OARB. Remedial activities by the Army included the following:

- Removed aboveground storage tanks ("ASTs") and underground storage tanks ("USTs").

- Excavated contaminated soil and skimmed separate phase petroleum hydrocarbons from monitoring wells at former tank locations.

- Excavated pesticide-containing soil from the off-site wetlands adjacent to the Building 991 area.

- Tested and replaced some transformers and electrical equipment containing polychlorinated biphenyls ("PCBs") with transformers and equipment that do not contain PCBs.

For purposes of this RAP, the findings and data compiled as a result of the Army's investigative and remedial activities have been evaluated together with information derived from investigations not conducted by the Army. The investigations completed by others and those recently performed by OBRA are described below. Environmental data from the Army's investigations at OARB through January 2002, as provided electronically to OBRA, are provided in Appendix A. Recent Phase II Investigations are discussed separately below.

4.3 INVESTIGATIONS BY OBRA AND OTHERS

Besides the Army, the Caltrans, the Army and Air Force Exchange Services ("AAFES"), and, most recently, OBRA have conducted investigations on portions of the OARB.

4.3.1 Caltrans Sampling Associated with I-880 Freeway Reconstruction

The Loma Prieta earthquake in 1989 severely damaged sections of the I-880 freeway system that surrounds the OARB. In 1994, Caltrans retained Environmental Assessors, Inc. to sample soil in the area below the West Grand Avenue overpass that was undergoing reconstruction due to seismic damage. The Caltrans sampling was conducted on OARB property in connection with the reconstruction of the West Grand Avenue overpass that crosses the OARB. Sampling was intended to determine the magnitude of chemical impacts to soil to establish appropriate health and safety protocols within the Caltrans work area, and to characterize the soil for disposal purposes.

Approximately 111 soil samples were collected and analyzed for lead (Environmental Assessors, Inc., 1994). Smaller numbers of samples were tested for total petroleum hydrocarbons ("TPH"), VOCs, semi-volatile organic compounds ("SVOCs"), pesticides, and PCBs. No widespread contamination was found in the area investigated by Caltrans.

The highest lead concentration measured in soil was 1,300 mg/kg (Environmental Assessors, Inc., 1994). Most soil samples contained lead less than 25 mg/kg. Minor amounts of petroleum hydrocarbons were also found in soil below the West Grand Avenue overpass. Analytical results obtained by Caltrans at the OARB are incorporated into the electronic database that was relied upon to prepare this RAP.

4.3.2 AAFES Phase II Investigation

In 1996, AAFES considered acquiring 72 acres of the OARB that included Buildings 802 through 808; Buildings 812, 815, 821, 822, and 823; and the western half of the Knight Railyard. In connection with this potential property acquisition, Camp Dresser & McKee, Inc. ("CDM") performed a Phase II investigation on behalf of AAFES. Soil or grab groundwater samples were collected from approximately 110 locations in this portion of the OARB (CDM, 1996). The findings of the investigation confirmed the presence of VOCs in groundwater at the eastern end of Building 807 that was discovered in 1992. Section 4.4.3.2 discusses this VOC-impacted site in greater detail. CDM also found that "grab" groundwater samples had relatively high concentrations of arsenic, barium, cadmium, chromium, and lead. It must be emphasized that these high metal concentrations are not considered representative because the grab groundwater samples were not filtered to eliminate turbidity effects as explained below.

High levels of turbidity interfere with accurate quantification of metals in groundwater because detected concentrations of metals are often associated with suspended solids that became entrained in groundwater during sampling and are not present otherwise. Puls and Powell (1992) of U.S. EPA state:

> R.S. Kerr Environmental Research Laboratory (RSKERL) personnel have evaluated sampling procedures for the collection of representative, accurate, and reproducible ground water quality samples for metals for the past four years. Intensive sampling research at three different field sites has shown that the method by which samples are collected has a greater impact on sample quality, accuracy, and reproducibility than whether the samples are filtered or not. In particular, sample collection practices that induce artificially high levels of turbidity have been shown to have the greatest negative impacts on sample quality.

U.S. EPA (1997c, 1995a) recommends that groundwater samples be collected by low-flow sampling techniques from properly constructed, developed, and purged monitoring wells to minimize turbidity. However, for groundwater samples that have turbidity levels greater than 5 nephelometric turbidity units ("NTU"), U.S. EPA (1997c) states that an in-line filter should be employed to collect the samples. According to U.S. EPA (1997c), "in-line filtering provides samples which retain their chemical integrity."

Cal / EPA has reached similar conclusions as those of U.S. EPA. In its *Guidance Manual for Groundwater Investigations*, Cal / EPA (1994) states:

> Filtered samples for dissolved metals analysis should be used whenever ground water samples are collected to determine if water quality has been affected by a hazardous substance release that includes metals as a constituent of concern.

With regard to groundwater samples collected at the OARB, DTSC (2001a) commented in a letter to the Army that it:

> recognizes the Army's position that unfiltered groundwater samples, or samples from temporary wells, are not useful because of high turbidity resulting from the use of grab samples. The solution to this problem is to collect better samples. It has been and remains DTSC's position that unfiltered samples or samples from temporary wells, if adequately collected, are needed for risk assessment.

DTSC (2001a) requested that an evaluation be performed to confirm that fill at the OARB is not leaching elevated concentrations of metals to groundwater such as those measured in AAFES grab groundwater samples.

Potential concern about metal contents of the fill at the OARB appears to be unfounded when the analytical results of properly collected water samples are examined. For example, low turbidity groundwater samples were obtained by the Army from 13 monitoring wells throughout the OARB in 2000 to provide additional data for the RI and investigation of former petroleum tank sites (IT, 2001e). The turbidity levels in these groundwater samples were generally less than 5 NTU, and no significant differences were observed between the analytical results of filtered and unfiltered groundwater samples from the monitoring wells. These groundwater samples did not contain metal concentrations greater than federal or State of California promulgated MCLs; thereby demonstrating that groundwater has not been appreciably impacted by metals naturally occurring in fill or otherwise from chemical releases at the OARB.[11] Very low metal concentrations are measured in groundwater at the OARB when care is exercised to collect samples that do not have excessive turbidity. In other words, high turbidity produces analytical results that overestimate concentrations that are actually dissolved in water because naturally occurring metals associated with suspended solids are reported as being dissolved in groundwater when in fact they are not. Metal analyses of unfiltered grab groundwater samples obtained in 1996 by CDM for AAFES and those later generated by others are not considered further in this RAP. Section 5 describes the approach followed by OBRA to screen available data to identify COCs at the OARB.

4.3.3 OBRA Review of Historical Documents

In September 2001, OBRA retained Erler & Kalinowski, Inc. ("EKI") to provide technical assistance for completing the FOSET process for early transfer of the OARB. As part of these services, EKI accomplished a partial review of primary historical documents (e.g., historical property cards, property vouchers, engineering drawings, historical maps, aerial photographs, and other documents) stored in the Army Base Transition Office at the OARB. The findings from this review by OBRA have been incorporated into this RAP / RMP.

4.3.4 Port of Oakland Review of Historical Documents

On behalf of the Port of Oakland and in conjunction with the Port of Oakland's Environmental Health and Safety Compliance Department, BASELINE Environmental Consulting ("BASELINE") conducted a review of historical information pertaining to the PDA (i.e., portions of the OARB to be transferred to the Port). The information reviewed by the Port included historical property cards, property vouchers, historical maps, aerial photographs, and other documents to assess potential sources of chemical impact. The findings from this review were documented in *Additional Information Report, Oakland Army Base, Oakland, California* (BASELINE, 2002). The findings from this review by the Port of Oakland have been incorporated into this RAP / RMP.

4.3.5 Army / OBRA Phase II Investigations

The findings from OBRA's and the Port of Oakland's review of historical documents and the various Army RI and FS reports led OBRA to decide to conduct a Phase II

[11] The comparison with MCLs is intended solely to illustrate that metals in groundwater are not a concern at the OARB. MCLs are not pertinent cleanup standards because groundwater at the base is so brackish that it cannot be used as drinking water supply (see Section 3.5.1).

Investigation in concert with the Army to further refine the understanding of environmental conditions at the OARB prior to transfer. Sampling activities were conducted in May 2002. Analytical results of sampling activities conducted by OBRA are described in EKI's report entitled *OBRA Phase II Investigation Data Report, Oakland Army Base, Oakland, California*, dated 12 June 2002 (EKI, 2002). Analytical results of sampling activities conducted by the Army are described in IT's report entitled *Draft Phase II Supplemental Investigation Report, Oakland Army Base, Oakland, California*, dated 24 June 2002 (IT, 2002a). Phase II Investigation data pertaining to identified RAP sites and RMP locations are briefly summarized in Sections 4.4.3 and 4.4.4, and are included in electronic data files provided in Appendix A.

The Phase II Investigation data collected by the Army and OBRA have been considered in the evaluation of remedial alternatives for the OARB. However, because Phase II Investigation data were collected as part of a voluntary sampling program to support a real estate transfer agreement without the DTSC reviewing sampling proposals, the data may or may not meet the quality objectives required for CERCLA remediation projects. The Phase II analytical results will be further evaluated by the DTSC in consultation with OBRA, as described in Section 5 of the RMP (Appendix E).

4.4 SUMMARY OF CHEMICAL RELEASE SITES AND LOCATIONS

In most instances, contamination of soil and groundwater at the OARB is relatively minor. Army operations were limited chiefly to warehousing and shipping of cargo overseas and did not include the kind of manufacturing activities that occurred at many other, larger San Francisco Bay Area military bases. Identified chemical impacts derive mostly from the use of petroleum products for activities that supported the OARB's primary military mission as a distribution center. Support activities included maintaining and fueling railroad locomotive engines and trucks that transported cargo, draining fluids from vehicles for overseas shipment, and repairing and servicing vehicles, equipment, and base facilities (IT, 2001a).

The most significant subsurface contamination found at the OARB is evidently due to operation of the ORP that took place in the 1920s and 1930s and preceded Army occupancy. Tarry residue from the ORP was deposited in an area near where Building 1 now stands and extends under Building 1. The former ORP / Building 1 area is discussed in Section 4.4.3.1.

4.4.1 Sites with COCs Greater Than Screening Levels for Unrestricted Use

The RAP identifies several RAP sites and RMP locations with releases of COCs at concentrations that exceed risk-based screening levels for unrestricted redevelopment of the OARB. As described in greater detail in Section 5, these areas have been identified by evaluation of representative data pursuant to U.S. EPA protocols (1989d). Any area where chemicals in soil or groundwater have been detected at concentrations greater than screening levels is a site that has been identified as potentially requiring remedial action for purposes of evaluation in this RAP. The RAP also addresses areas for which environmental data are lacking but reviews of use histories conducted by the Army and others suggest the potential for chemical releases that may be incompatible with unrestricted land use.

Although hypothetical, unrestricted land use was assumed in screening chemicals at the OARB, the Amended Reuse Plan contemplates that the OARB will be redeveloped for commercial and industrial purposes only. The NCP and, therefore, a RAP prepared under Chapter 6.8 of the California HSC that must be based upon the NCP do not contemplate remediating contaminated property to allow for unrestricted future residential use if such use is not reasonably anticipated in the future. With respect to this point, U.S. EPA (1995d) states in its Superfund Land Use Directive that "in cases where the future land use is relatively certain the remedial action objective generally should reflect this land use." U.S. EPA (1995d) also states that:

> the volume and concentration of contaminants left on-site, and thus the degree of residual risk at a site, will affect future land use. For example, a remedial alternative may include leaving in place contaminants in soil at concentrations protective for industrial exposures, but not protective for residential exposures. In this case, institutional controls should be used to ensure that industrial use of the land is maintained and to prevent risks from residential exposures.

Consequently, a more realistic view is taken when establishing RAOs for the purpose of assembling remedial alternatives. RAOs for OARB sites reflect the reasonably anticipated commercial and industrial land uses in conjunction with institutional controls prohibiting unrestricted land use. RAOs lead to practicable and cost-effective remedial alternatives consistent with the NCP and U.S. EPA Superfund Land Use Directive. Further, U.S. EPA (2001e) has found that integrating realistic assumptions of future land use into remedial actions is an important step toward encouraging cleanup and redevelopment of contaminated properties. Identification of COCs is discussed in greater detail in Section 5. RAOs for OARB sites are presented in Section 7.

4.4.2 Categorization of Chemical Release Areas

Known and potential chemical release areas at the OARB are shown on Figure 4-1 and were divided into RAP sites and RMP locations as discussed below. RAP sites are shown in solid green or blue hatching on Figure 4-1. RMP locations are shown in brown on this same figure.

4.4.2.1 RAP Sites

RAP sites consist of seven areas that require remediation to protect human health and the environment. Effective remediation of RAP sites is not anticipated to be cost-effectively implemented as part of redevelopment and will be started prior to redevelopment to prevent conflicts with land reuse. Residual contamination found at these locations may not be sufficiently characterized or may not be adequately remediated as part of activities performed during or after redevelopment.

Greater amounts of time are also potentially needed to implement active measures to reduce VOCs in groundwater to concentrations less than applicable remediation goals at currently identified sites with VOC-impacted groundwater, such as Building 807, Buildings 808 and 823, and Building 99. Alternatively, if active measures are not selected as remedies to reduce VOC concentrations at these sites, engineering controls can be designed and incorporated into new building construction to mitigate the vapor intrusion exposure pathway that potentially exists. However, adequate time must still be allowed to incorporate the design of engineering controls in new building construction. The evaluation of potential human health risks associated with vapor intrusion is discussed in Section 7.3.

A RAP site may be added by amendment to this RAP where a location at the OARB cannot be appropriately managed under the RMP or under the remedial technologies retained in this RAP. Protocols for identifying additional RAP sites are discussed in Section 5 of the RMP.

4.4.2.2 RMP Implementation Area

The RMP Implementation Area consists of all areas of the OARB to be transferred to OBRA via the EDC, including, for example, numerous RMP locations which involve documented or suspected small releases of petroleum hydrocarbons to soil. Certain interim use sites, identified in Appendix D, are also included within the RMP Implementation Area. Petroleum releases have impacted shallow groundwater to a minor extent at some of the RMP locations. In response, routine groundwater monitoring is being conducted to fulfill closure requirements imposed by RWQCB. Such petroleum-impacted areas are common at former industrial properties undergoing redevelopment in the San Francisco Bay Area. Developers, contractors, and governmental agencies have found that these types of releases can be easily managed during new construction through application of an RMP.

An RMP is sometimes referred to as a Contingency Plan, a Soil Management Plan, or a Remediation and Risk Management Plan. The RMP is considered analogous to a CERCLA Operation and Maintenance Plan. The Operation and Maintenance Plan is a typical component of remedial actions and includes protocols for conducting inspections, performing routine sampling, maintaining institutional (e.g., covenants, groundwater use restrictions) and engineering (e.g., cover integrity, wells) controls, and fulfilling reporting obligations (U.S. EPA, 2001f). The objectives and contents of the RMP are similar. The RMP for the OARB describes the health protective measures to be implemented in the future, during and after redevelopment, for identified chemical release sites, land uses, and potential exposure pathways. Institutional controls will obligate owners and tenants of the OARB to update information in the RMP based on conditions encountered or upon changes in land uses, environmental statutes, or chemical toxicity information. The RMP is, thus, a component of the institutional controls included for all remedial actions in this RAP.

As discussed in more detail in Section 8, the NCP at 40 CFR §300.430(a)(1)(iii)(B) states that "U.S. EPA expects to use engineering controls, such as containment, for waste that poses a relatively low long-term threat or where treatment is impracticable." Buildings, asphalt roadways, concrete pavement, imported clean soil, and other cover types existing and planned at the OARB may adequately protect human health against direct contact with petroleum hydrocarbons and other COCs most frequently identified at RMP locations. This fact, coupled with available use history information and environmental data that indicate the RMP locations identified at the OARB consist primarily of petroleum hydrocarbon or low threat COC releases that have affected a small quantity of soil, makes the RMP locations relatively straightforward to address as they are encountered during or after redevelopment. For example, as construction proceeds, workers trained in the remediation of hazardous substance release sites can be mobilized to excavate identified areas of contaminated soil for subsequent reuse, if shown to be acceptable, or disposal at an off-site, permitted waste management facility.

For these reasons, OBRA proposes to address RMP implementation requirements in a phased manner that is consistent with the schedule for redevelopment of the OARB. In the event that the nature and extent of COC releases at RMP locations are found to differ significantly from the conditions described in this RAP, the appropriateness of remedial actions adopted for the OARB will be re-evaluated for such specific RMP locations. The RMP, which is provided as Appendix E to this RAP, specifies the situations under which response measures will be re-evaluated in consultation with DTSC and the procedures for elevating a RMP location to a RAP site, if appropriate.

4.4.3 Environmental Conditions at RAP Sites

Environmental conditions at RAP sites tend to be unique in one or more respects. As a result, the use history, and nature and extent of contamination are summarized separately in the sections below for each identified RAP site. Detailed discussions of the environmental conditions at these sites can be found in the RI reports and addenda prepared by the Army; refer to the reference list in Section 13. Analytical results of COCs in soil and groundwater are contained on the compact disc included as Appendix A. Identification of COCs for the OARB is discussed in Section 5.

4.4.3.1 Former ORP / Building 1 Area

The former ORP consisted of a building and several aboveground tanks at the approximate location shown on Figure 4-2. Review of historical aerial photographs taken in 1931 and 1939 show the ground to be stained around the building and tanks. IT (2001i) has postulated that dumping of tarry residue from waste oil recovery operations caused the staining observed in the historical photographs. The tarry residue was apparently covered by fill imported by the Army to construct Building 1 in 1941.

A portion of the tarry residue is a pliable, acidic semi-solid that demonstrates some mobility in the subsurface. In 1994, the asphalt parking lot between Wings 1 and 2 of Building 1 buckled due to tarry residue that flowed to the surface. The Army removed the material and repaired the parking lot. Four years later, in 1998, the Army excavated this same area in an effort to eliminate the tarry residue. The tarry residue could not be completely excavated because it extended under Wing 2 of Building 1.

In 2000, a video camera inspection of a sanitary sewer line that runs through the parking lot found tarry residue had infiltrated the sewer line through joints in the pipe. Also in 2000, tarry residue was observed to have migrated to the surface beneath the crawl space of Wing 1 of Building 1, approximately 120 feet to the southwest where the tarry residue was first noted in the parking lot in 1994. The tarry residue seemed to have exuded through a small gap between a wooden piling that supports the building and an edge of the concrete slab that exists below the building to discourage habitation by burrowing rodents and other vermin. The tarry residue was removed. Army representatives have indicated that the tarry residue has again been observed beneath the crawl space of Building 1 in March 2002. IT (2001i) described the physical appearance of tarry residue found beneath the crawl space of Building 1 as the following:

> The substance had a black skin that was stiff and slightly resilient, appearing to be an oxidized layer over a softer interior. When the outer layer was penetrated, a clear watery liquid welled up in the hole and bubbled and squirted out if under sufficient pressure. The clear liquid reacted with the concrete slab, producing a faint hissing and bubbling. A test with pH paper indicated a very strong acid (pH near zero). Faint traces of sulfurous and nitrous gases were noted.

Laboratory analysis (IT, 2000i) of the tarry residue has confirmed its acidic nature. Lead has been measured at a concentration as high as 11,800 mg/kg in the tarry residue. The material also contains polycyclic aromatic hydrocarbons ("PAHs"), PCBs, polychlorinated dibenzodioxins ("PCDDs"), and polychlorinated dibenzofurans ("PCDFs") at concentrations of concern. PCDDs and PCDFs are general references to dioxin-like compounds that are often found in complex mixtures. Table 4-4 summarizes analytical results for tarry residue samples collected beneath the crawl space of Building 1. The tarry residue does not appear to be contaminated with VOCs, although one sample of fill that overlies the tarry residue contained 320 µg/kg of 1,2,3-trichloropropane ("TCP").

The Army has compiled information on the distribution of tarry residue in soil at the Building 1 area by conducting laboratory analyses, field screening with a photoionization detector ("PID"), and noting on boring logs where discoloration or odor in soil have been observed. Figure 4-2 delineates the potential extent of tarry residue in soil based upon this information.

IT (2001i) calls the tarry residue that has migrated to the surface a "tar-like substance" or "soft, pliable, non-viscous black solid." However, the most common form of the tarry residue observed in soil samples collected from borings and trenches is a material that is characterized as a "dark to light brown fluid with the consistency and look of motor oil." The thickness of tarry residue in the subsurface varies from less than 0.5 feet to at least 3 feet. The full depth of tarry residue has not been determined at all locations. In the draft feasibility study ("FS") that considered the former ORP / Building 1 area, IT (2001i) estimated the in-situ volume of tarry residue to be approximately 6,000 cy that exists primarily between 3.5 to 5.5 feet bgs. IT also estimated the in-situ volume of TCP-impacted fill overlying the tarry residue to be roughly 2,000 cy distributed from ground surface to a depth of 3.5 feet bgs over the approximate 13,700 square foot ("sf") area shown on Figure 4-2. The volume estimates by IT are subject to considerable uncertainty and the actual quantities of tarry residue and any TCP-impacted soil that must be addressed by remedial actions may be greater or less than estimates by IT.

Review of available groundwater data does not suggest that the tarry residue contains significant quantities of soluble contaminants (IT, 2002c). The maximum concentrations of petroleum hydrocarbons in groundwater samples collected within the area believed to be impacted by tarry residue were 2.7 mg/L measured as TPH as gasoline and 6.5 mg/L measured as TPH as motor oil. Detected VOCs in the shallow water-bearing zone within this area have consisted of n-propylbenzene at 0.06 μg/L, vinyl chloride at 3.7 μg/L, toluene at 0.2 μg/L, and xylenes at 0.48 μg/L. No PAHs have been detected in groundwater samples above analytical method reporting limits. The highest concentration of lead measured in groundwater has been 264 μg/L.

The former ORP / Building 1 area is a RAP site because of the potential human health risks associated with the tarry residue. A portion of the tarry residue represents source material that displays mobility in the subsurface.

4.4.3.2 VOCs in Groundwater at Eastern End of Building 807

VOCs in the shallow water-bearing zone at the eastern end of Building 807 were discovered in 1992 during the drilling of foundation piers for a prefabricated building (CDM, 1996). Detected VOCs in groundwater in this area consist primarily of vinyl chloride, cis-1,2-dichloroethene ("cis-1,2-DCE"), trans-1,2-dichloroethene ("trans-1,2-DCE"), trichloroethene ("TCE"), and 1,1,2,2-tetrachloroethane. The VOCs are believed to have been released as a result of the Army's past practice of allowing drums of solvent, paint, or other chemicals that were damaged during shipping to drain along the railroad tracks in this area of the Knight Railyard. The PA/SI attributes the following statement to an environmental assessment of the OARB conducted by the United States Army Toxic and Hazardous Materials Agency ("USATHAMA") in 1988:

> In the past, damaged containers were placed adjacent to the tracks at the Knight Railyard. The containers were allowed to drain on the railroad ballast rock in this area, and any material which did not drain eventually was placed inside other containers for transport and disposal at authorized disposal sites. OARB changed this procedure after it was identified to management personnel as a potential problem. The installation then provided lined drums throughout the warehouses to receive any leaking or damaged containers.

The location where VOC-impacted groundwater was encountered at the eastern end of Building 807 is, however, approximately 200 feet northeast of the area identified by USATHAMA in its 1988 assessment as the location where the Army reportedly drained damaged containers. This latter area is identified as an RMP location and is discussed in Section 4.4.4.3.5.

Maximum VOC concentrations detected in shallow groundwater at the eastern end of Building 807 are vinyl chloride at 442 µg/L, cis-1,2-DCE at 2,020 µg/L, trans-1,2-DCE at 300 µg/L, TCE at 363 µg/L, and 1,1,2,2-tetrachloroethane at 200 µg/L in water samples collected from monitoring well ICFMW202. Nine monitoring wells in the shallow water-bearing zone define the lateral extent of VOC-impacted groundwater as shown on Figure 4-3. Review of water level and analytical data for these wells indicates that VOCs are not migrating. The limited extent of VOC migration in groundwater may reflect that groundwater velocity is low compared with the rate of sorption and degradation mechanisms (Kleinfelder, 1998a). In other words, the VOC distributions in the shallow water-bearing zone at eastern end of Building 807 appear to be at steady state.

Although investigations by the Army do not indicate that a significant chemical source remains in soil at this area, the residual VOC concentrations in groundwater may pose a vapor intrusion threat if a building is constructed over the area in the future. To allow such construction, remediation of VOCs in groundwater may need to be performed or new buildings may have to be designed with engineering controls that prevent infiltration of VOCs inside the structures. For these reasons, the area at the eastern end of Building 807 with VOCs in groundwater is considered a RAP site.

4.4.3.3 VOCs in Groundwater Near Buildings 808 and 823

Vinyl chloride and lesser concentrations of other VOCs are present in shallow groundwater in an area north of Building 808 and south of Building 823 (Figure 4-4). No significant soil contamination has been identified and the source of the VOCs is not known. Possible sources include Building 823, and storm drains and sanitary sewers that run through the area. Building 823 and storm drains and sanitary sewers are identified as RMP locations and are discussed in Sections 4.4.4.3.4 and 4.4.4.7, respectively.

Maximum VOC concentrations detected in shallow groundwater near Buildings 808 and 823 are vinyl chloride at 267 µg/L, cis-1,2 DCE at 13 µg/L, trans-1,2 DCE at 3.6 µg/L, TCE at 4.1 µg/L, and 1,1-dichloroethene ("1,1-DCE") at 2 µg/L. VOCs in shallow groundwater near Buildings 808 and 823 appear to be in steady state and are not migrating.

The lateral extent of VOC-impacted shallow groundwater was further delineated as part of OBRA's Phase II Investigation (EKI, 2002). VOCs at individual concentrations of less than 5 µg/L were detected in groundwater along the southern edge of this area. VOC-impacted groundwater near Buildings 808 and 823 is considered a RAP site because of the potential vapor intrusion threat posed by residual VOCs in groundwater.

4.4.3.4 VOCs in Groundwater Near Building 99

As shown on Figure 4-5, an area of the shallow water-bearing zone near Building 99 is impacted with VOCs. The predominant VOCs detected in groundwater are vinyl chloride and cis-1,2-DCE. No significant soil contamination has been identified and the source of the VOCs is unknown. Possible sources include Building 99 (Section 4.4.3.7) which is identified as a RAP site, and storm drains and sanitary sewers (Section 4.4.4.7) which is identified as a RMP location.

Vinyl chloride and cis-1,2-DCE have been detected at maximum concentrations of 29 µg/L and 41 µg/L, respectively. The impact of vinyl chloride and cis-1,2-DCE to shallow groundwater in this area has been fully delineated. VOC-containing groundwater near Building 99 is considered a RAP site because of the potential vapor intrusion threat posed by residual VOCs in groundwater.

As part of its Phase II Investigation, the Army conducted groundwater sampling to characterize the lateral extent of VOC impacts to shallow groundwater along the eastern edge of this area (IT, 2002a). VOCs detected in groundwater in this area included cis-1,2-DCE at a maximum concentration of 8.3 µg/L, vinyl chloride at a maximum concentration of 13.8 µg/L, PCE at a maximum concentration of 7 µg/L, and carbon disulfide at a maximum concentration of 4 µg/L. VOCs in shallow groundwater near Building 99 appear to be in steady state and are not migrating beyond the defined plume area.

4.4.3.5 Benzene and MTBE in Groundwater Near Former USTs 11A/12A/13A

Building 828 was a former Army vehicle service station. Three 5,000-gallon gasoline USTs, designated USTs 11/12/13, were installed west of Building 828 in 1969. These tanks were replaced with three 6,000-gallon gasoline USTs, designated 11A/12A/13A, in 1990. The Army removed tanks 11A/12A/13A in 1999. Following the tank removals, significant concentrations of petroleum hydrocarbons, and benzene, toluene, ethylbenzene, and xylenes ("BTEX") remain in soil and shallow groundwater near the location of the former tanks. Methyl tertiary butyl ether ("MTBE"), which is a fuel oxygenate, is also detected in the shallow water-bearing zone near Former USTs 11A/12A/13A. Results from recent monitoring well sampling (IT, 2002g) show MTBE concentrations as high as 10,000 µg/L have been detected in groundwater. Recent maximum concentrations of other fuel constituents include TPH measured as gasoline at 26,400 µg/L, benzene at 1,880 µg/L, toluene at 3,910 µg/L, and xylenes at 3,510 µg/L. The lateral extent of fuel constituents in the shallow water-bearing zone is shown on Figure 4-6.

BTEX and MTBE are volatile constituents of petroleum fuels. The area near former USTs 11A/12A/13A impacted by these compounds is considered a RAP site because of the potential vapor intrusion threat posed by BTEX and MTBE in the subsurface. BTEX and MTBE in groundwater at USTs 11A/12A/13A appear to be in steady state, and this area is also in corrective action monitoring with the RWQCB.

4.4.3.6 Building 991 Area

The Army constructed Building 991 in 1942 as a locomotive engine maintenance shop. The building was used from 1942 to 1997 to repair, clean, and fuel engines (IT, 1999). Extensive chemical use and handling has occurred at this area. As a result, petroleum hydrocarbons and lesser concentrations of other COCs have impacted soil and groundwater in the vicinity of Building 991. MTBE has been detected at low concentrations in groundwater near Building 991; the source of the MTBE is unknown.

Sanitary sewage from Building 991 initially discharged to a chemical tank (BASELINE, 2002). It is not known if the tank was removed or remains on-site. Sometime before 1976, the chemical tank was replaced with the septic tank and an associated leach field. The leach field extended outside the boundary of the OARB. Floor drains and a lubrication pit and sump inside Building 991 discharged to a gravel-filled trench adjacent to the west wall of Building 991 and through an oil/water separator (BASELINE, 2002; IT, 1999). The oil/water separator may have been installed in early 1974, but was never maintained (BASELINE, 2002). According to the PA/SI, the oil/water separator discharged to an undersized septic tank that caused the associated leach field to clog. An eight-inch vitrified clay pipe and four-inch cast iron pipe were used to the drain the septic tank and oil/water separator, and the leach field, respectively. The locations of the outfall from these pipes are unknown, and may be located off site (BASELINE, 2002). The outfalls may be the source of an oil-soaked area at the northern boundary of the OARB behind Building 991 (BASELINE, 2002).

A sample of sediment collected inside of the drain line from the septic tank contained 7,300 mg/kg of petroleum hydrocarbons measured as motor oil, 190 µg/kg of PCBs, and various metals (IT, 1999). Although the Army removed the oil/water separator, septic tank, and portions of the septic tank drain line, soil and groundwater in the vicinity of these former structures remain impacted by petroleum hydrocarbons.

A 10,000-gallon AST located outside of Building 991 (Figure 4-7) supplied diesel fuel to a dispenser inside the building. In May 1997, an estimated 780 gallons of diesel fuel spilled while a tanker truck was supplying the AST (IT, 1999). Over 430 tons of impacted soil was excavated, but contaminated soil was not removed near a railroad trestle due to the potential for weakening the structural integrity of the trestle.

Chemical releases may have occurred near Facility 992, which was formerly located west of Building 991. Waste oil and naphtha solvent were stored in this facility. IT (1999) reports that naphtha solvent was used to clean engine parts.

From 1984 to 1995, engines were reportedly washed with water and water-based detergent on the railroad tracks in front of Building 991. Until the late 1970s, engines had been washed on a concrete slab southeast of Building 991 (Figure 4-7). A sump, connected to the slab, discharged wash water to the off-site wetlands situated between the railroad tracks. Besides cleaning engines, pesticide application equipment was occasionally rinsed on the slab (IT, 2002f).

Investigations of the wetlands by the Army confirmed pesticide impacts to soil. In response, the Army sealed the sump in-place with cement grout and excavated approximately 950 cy of impacted soil. Pesticides remain in on-site soil along the eastern property boundary. Residual pesticides, if any, remaining in sediment or groundwater in the off-site wetland area are not considered in this RAP and will be addressed separately as discussed in Section 2.4.

The Army conducted sampling at the Building 991 area as part of its Phase II Investigation to determine the source of immiscible diesel fuel product floating on groundwater in monitoring well CE-3 (IT, 2002a). TPH quantified as diesel ("TPHd") and TPH quantified as motor oil ("TPHmo") were detected in soil at concentrations up to 1,200 mg/kg and 2,100 mg/kg, respectively. TPHd and TPHmo were also detected in groundwater at concentrations up to 590 μg/L and 66 μg/L, respectively. However, no additional product floating on groundwater was found.

The Building 991 area is considered a RAP site because of the multiple releases of petroleum hydrocarbons, pesticides, and other hazardous substances that are known or suspected to have occurred at this area. Abatement of residual soil and groundwater contamination may be necessary to protect human health and the environment, given the planned redevelopment of the Building 991 area.

4.4.3.7 Building 99

Building 99 was constructed in 1918 and used by Union Construction Company for ship manufacturing until the mid-1930s (IT, 2000i, 2000j). From the mid-1930s until the Army's acquisition of the property in 1941, Pacific Coast Engineering Company conducted metalworking operations in Building 99 that were related to production of structural iron and piping. During that time, the northern portion of the building contained a furnace, and blacksmith and machine shops. The middle portion of the building was used for plate rolling. The southern portion of the building contained a plate shop. Metal plates were marked, cut, shaped, and fastened inside the building (IT, 2000i).

In 1941, the Army apparently converted Building 99 to a vehicle and electrical maintenance shop and installed a metal shop and paint room in the structure (IT, 2000i). A report by the Army Industrial Hygiene Laboratory, dated December 1944, indicates that Building 99 also contained a jitney repair shop; truck repair shop for welding and "metallizing" (i.e., spraying metal); and a shop where hot copper pipe was pickled in a 10 percent by weight sulfuric acid solution, and where metal brazing, silver soldering, and "lead burning" were carried out. According to this Army report, sand blasting was performed outside the building and dust produced by the operation was allowed to blow about without any attempt to control it. The exact location of the sand blasting area is unknown.

A gas fired boiler and a steam cleaner inside Building 99 were identified on property cards for Building 99 (BASELINE, 2002). They were removed from the building in June 1961. The location of the steam cleaner room is unknown and was not located on any of the maps reviewed by the Port of Oakland. A used oil accumulation area was also located along the western side of Building 99 (BASELINE, 2002). More recently, the northern portion of Building 99 was used for the repair and maintenance of tractor-trailers operated by AAFES (IT, 2000k).

The Army has advanced four soil borings beneath Building 99 that are identified as ICF10S10, ICF10S11, ICF10S12, and ICF10S13. Soil samples collected from the borings were analyzed for VOCs, PAHs, TPH, and metals. Analytical results of these samples do not suggest significant releases have occurred from the building. Minor concentrations of VOCs, PAHs, and TPH were measured in soil samples collected from borings ICF10S10, ICF10S11, ICF10S12, and ICF10S13. No metals were detected in soil samples collected from the borings at concentrations greater than naturally occurring levels reported for common soil types in Oakland.

Groundwater in the Building 99 area has been extensively investigated, and VOC and petroleum hydrocarbon impacts to the shallow water-bearing zone are generally well characterized (see Section 4.4.3.4). Additional groundwater contamination attributable to Building 99 is not anticipated.

RAP sites near Building 99 include groundwater impacted by vinyl chloride and cis-1,2-DCE (Section 4.4.3.4). RMP locations near Building 99 include a debris area (Section 4.4.4.3.1), Building 85 (Section 4.4.4.3.2) and storm drains and sanitary sewers (Section 4.4.4.7), USTs B, C, and Q; a former paint shop and former paint storage shed; and a vehicle washrack (i.e., Facility 98) with an associated oil/water separator (Figure 4-8).

Building 99 is categorized as a RAP site because it has been used for ship manufacturing, metalworking, and equipment repair beginning in 1918. The Army completed one soil boring at Building 99 as part of its Phase II investigation. The only organic COCs detected were petroleum hydrocarbons in soil samples at concentrations less than the remediation goals in Table 7-11. Selected metals were present in soil and groundwater samples at ambient concentrations. Given the historical uses at Building 99 and the limited nature of the Phase II Investigation, additional sampling at Building 99 may be warranted to confirm the findings of available data that show no significant chemical releases to soil (IT, 2002a). Additional sampling, if any, will be conducted in connection with the remedial actions for Building 99.

4.4.4 Environmental Conditions at RMP Implementation Area

Environmental conditions at the remainder of the OARB, including a variety of RMP locations, generally involve common classes of chemicals (i.e., petroleum hydrocarbons, lead, PCBs) related to oily wastes. RMP locations have been grouped either according to the types of chemicals likely to be present or the historical activities that took place. The following sections summarize the use history, and nature and extent of contamination for each group of RMP locations.

4.4.4.1 <u>Washracks, Sumps, Oil/Water Separators, and Miscellaneous Operations</u>

Approximately 82 washracks, sumps, oil/water separators, other below grade structures, and miscellaneous items have been identified at approximately 55 locations on the OARB. The lower number of actual locations is because many of the structures are often connected to one another. For example, a washrack is often connected to a sump or oil/water separator. As summarized in Table 4-2, this category of RMP locations is further divided into four subgroups: (1) locations requiring the removal of an existing structure, (2) locations requiring additional characterization, (3) location potentially requiring removal of impacted soil during infrastructure installation or redevelopment, and (4) locations with no currently identified environmental issues but which will be inspected for undiscovered contamination in accordance with the soil management protocols in the RMP. Petroleum hydrocarbons and metals in soil are the known or suspected COCs at most of these locations.

The Army and OBRA performed sampling at some of these washracks, sumps, oil/water separators, and miscellaneous operations as part of the Phase II Investigations. The results of these sampling activities are included in reports prepared by the Army (IT, 2002a) and EKI (2002) on behalf of OBRA, and confirm that these locations can be readily addressed by the protocols established in the RMP.

4.4.4.2 Tanks

Approximately 93 USTs and ASTs have been identified at approximately 73 locations on the OARB. Similar to washracks, sumps, oil/water separators, and miscellaneous items, the lower number of actual locations is because certain tanks were clustered together. As summarized in Table 4-3, tank locations are further divided into four subgroups: (1) tank locations that potentially require the removal of an existing tank, (2) former tank locations potentially requiring removal of impacted soil during infrastructure installation or redevelopment, (3) former tank locations potentially requiring both removal of impacted soil during infrastructure installation or redevelopment and groundwater monitoring, and (4) former tank locations with no currently identified environmental issues but which will be inspected for undiscovered contamination in accordance with the soil management protocols in the RMP.

Some of the tank locations were identified from a review of historical drawings and documents conducted by OBRA, the Port of Oakland (BASELINE, 2002) and the Army, and the presence of a tank is only suspected. As part of its Phase II Investigation, the Army researched or otherwise investigated 30 tank locations where it was unclear whether a tank existed (IT, 2002a). The Army investigated 24 of these 30 potential tank locations after information collected by the Army indicated that 6 of the potential tank locations required no further action. The geophysical survey performed by the Army recorded anomalies indicative of buried tanks at 8 of the remaining 24 locations. At 14 locations, the Army completed two borings at each location and collected soil and groundwater samples.

TPHd and TPHmo were detected in soil at 5 of the 14 tank locations sampled by the Army in its Phase II Investigation. At UST 678, TPHd and TPHmo were detected at concentrations up to 3,980 mg/kg and 580 mg/kg, respectively. At UST 688, TPHd and TPHmo were detected at concentrations up to 1,100 mg/kg, and 41 mg/kg, respectively. No VOCs were detected in soil except for acetone measured at concentrations of 0.04 mg/kg and 0.018 mg/kg at USTs 678 and 679, respectively.

Methylene chloride was detected in groundwater at tank locations 673, 678, and 688 at concentrations ranging from 85 μg/L to 560 μg/L. PCE and TCE were also detected in one groundwater sample collected near UST 678 at concentrations of 390 μg/L and 46 μg/L, respectively. Other VOCs detected in groundwater in this area near tank locations 678 and 688 included acetone up to 1,300 μg/L, sec-butylbenzene up to 390 μg/L, and n-propylbenzene up to 320 μg/L. These concentrations of VOCs in groundwater are less than the groundwater remediation goals in Table 7-11, and can be readily addressed by the protocols established in the RMP. TPHd was detected in groundwater at tank locations 673 678, 682, 686, and 688 above the groundwater remediation goals in Table 7-11.

Petroleum fuels and related constituents in soil are the known or suspected COCs at the majority of locations where tanks have been removed. Most former tank locations have been closed by RWQCB. Natural attenuation of petroleum hydrocarbons in shallow groundwater is being monitored at seven tank locations under RWQCB supervision. The newly discovered petroleum tank locations and associated releases will also require closure by RWQCB.

On behalf of OBRA, Innovative Technical Solutions, Inc. ("ITSI") evaluated the potential quantities of contaminated soil that may still remain at the former tank locations. ITSI (2001) estimates that the total volume of petroleum hydrocarbon-containing soil at all tank locations may be on the order of 4,000 cy. These petroleum residuals will be addressed during redevelopment by the soil management protocols in the RMP.

4.4.4.3 Former Industrial and Chemical Handling Locations

Seven locations were identified by OBRA where former industrial activities or chemical handling took place for which little or no subsurface environmental data were available. Although no significant contamination was known to exist at these locations, historical operations suggested the likelihood for past chemical releases. As part of the Phase II Investigations, the Army and OBRA conducted sampling activities at many of these locations to characterize subsurface environmental conditions.

4.4.4.3.1 Debris Area Near Building 99

The Army encountered debris while removing buried waste oil piping in Corregidor Street west of Building 99 (Figure 4-8). The debris consisted of ACM and lesser amounts of charred wood, slag, burned coke material, and refractory brick, which the Army believes originated from a boiler (IT, 2002e). Approximately 15 tons of soil mixed with the so-called "boiler debris" was excavated by the Army during removal of the waste oil piping and disposed as a non-RCRA hazardous waste.

OBRA excavated four test pits and collected samples of debris in the "boiler debris" area as part of its Phase II Investigation. The locations of the test pits and the associated soil sampling locations inside the pits are shown on Figure 3 in the *OBRA Phase II Investigation Data Report* (EKI, 2002). Debris mixed with black and dark brown sand was observed in all four test pits. Debris noted in the test pits included pieces of concrete; burned wood; nails, bolts, and other metal fasteners; possible leather and asbestos scraps; ceramic tile made of 2-inch hexagons; gray slate; and vesicular slag.

The debris and sand mixture contained lead and other metals at concentrations greater than remediation goals in Table 7-11. The debris and sand mixture also contained benzo(a)pyrene at concentrations greater than the remediation goal. Other PAHs were detected, but at concentrations below the remediation goals in Table 7-11. Up to 6,000 mg/kg of petroleum hydrocarbons were measured in samples of the debris and sand mixture.

Lead was also detected at a concentration of 3,550 mg/kg in a soil sample collected from the soil boring for monitoring well ITMW243 by the Army as part of its Phase II Investigation. This monitoring well is located approximately 100 feet north of the debris area.

Given the COC concentrations in the debris and sand mixture and the fact that the lateral extent of this material has not been delineated, additional characterization of the debris area is needed before an appropriate remedial action can be implemented. The scope of investigations to be performed at the debris area near Building 99 will be evaluated in consultation with DTSC as specified in the RMP.

4.4.4.3.2 Building 85

A 1943 map of the OARB designates Building 85 (Figure 4-8) as the area engineer's office. The building appears to have been used chiefly to carry out administrative functions. However, review of floor plans, dated 25 April 1960, show Building 85 was equipped with a photograph-processing laboratory. IT (2000i) states that Building 85 was also historically used as a printing plant, but no basis for this statement is provided. IT may be referring to the photograph-processing laboratory when it concludes that the building was a printing plant.

The Army and OBRA performed soil and groundwater sampling at Building 85 as part of the Phase II Investigations. OBRA analyzed splits of soil and groundwater samples obtained by the Army for petroleum hydrocarbons and PCBs. No petroleum hydrocarbons or PCBs were detected in the split samples at concentrations greater than analytical method reporting limits. Soil samples collected and analyzed by the Army did not contain VOCs, PAHs, TPH, pesticides, or PCBs. Vinyl chloride was detected at 0.6 µg/L in a groundwater sample obtained by the Army. This vinyl chloride concentration is considerably less than the remediation goal in Table 7-11. Selected metals were present in soil and groundwater samples at ambient concentrations. These additional data confirm that Building 85 can be readily addressed by the protocols established in the RMP.

4.4.4.3.3 Building 812

The Army constructed Building 812 in 1944. The Army states the building was used as an "ordnance" maintenance shop until 1950. Building 812 reportedly contained a welding booth, machine shop, and two repair and grease areas (Figure 4-9). The term "ordnance," as applied by the Army to the OARB and certain other embarkation installations in the San Francisco Bay Area, did not mean ammunition or explosives, but instead referred to vehicles and other mechanized equipment shipped from the installations (Hamilton and Bolce, 1946). The notion that the term "ordnance" pertains to vehicles is consistent with the use history of Building 812.

Review of Army historical equipment records reveals the building contained various metal working equipment, including drill presses, metal cutting machinery, lathes, a milling machine, and a shaper. By 1969, Building 812 had been transformed to include a tune-up and lube area, tire shop, battery shop, parts room, office machine repair shop, sheet metal shop, mechanical and welding maintenance shop, and a large centralized crane area in the center of the building. Chlorinated organic solvents were historically used in Building 812. Chlorinated solvent usage was discontinued in the mid-1980s, when a parts-washing system that used high-pressure water and water-based solvents was installed (USATHAMA, 1988). Other industrial operations and storage activities at Building 812 included metal cold cleaning (IT, 2000i) and storing drums containing new and used petroleum products outside on pallets with no secondary containment

(Kleinfelder, 1998b). Used oil tank 8A was formerly located at the southwest corner of Building 812.

No significant contamination has been identified near Building 812 based upon the results of soil gas sampling conducted during the PA/SI, and soil and groundwater testing related to the removal of used oil tank 8A. Soil gas samples contained low concentrations of VOCs. Soil from the excavation pit of used oil tank 8A contained a maximum petroleum hydrocarbon concentration of 250 mg/kg. Residual petroleum hydrocarbons of 7,600 μg/L were measured in water present in the pit at the time of excavation, but no petroleum hydrocarbons or related constituents were detected in groundwater samples collected from borings placed in the shallow water-bearing zone outside of the boundaries of the pit.

The Army and OBRA conducted sampling activities at Building 812 as part of the Phase II Investigations. The only organic COCs detected were PAHs and petroleum hydrocarbons in soil samples at concentrations less than the remediation goals in Table 7-11. Selected metals were present in soil and groundwater samples at ambient concentrations. These additional data confirm that Building 812 can be readily addressed by the protocols established in the RMP.

4.4.4.3.4 Building 823

Building 823 first appears on a 1943 map of the OARB. Army historical documents show that Building 823 contained a paint room, paint booth finishing room, and carpenter shop. A report by the Army Industrial Hygiene Laboratory, dated December 1944, indicates Army personnel stripped paint with chemicals that included chlorinated solvents. IT (2000i) states that Building 823 was also used as a heavy equipment maintenance facility, but the locations and types of equipment and chemicals that were involved with this operation are unknown. Identified chemical release locations near Building 823 include former UST A and the VOC-impacted groundwater near Buildings 808 and 823 (Section 4.4.3.3). Besides petroleum hydrocarbons and related constituents associated with UST A, no residual chemical sources in soil have been identified at Building 823 (Figure 4-10).

Phase II Investigation soil samples contained petroleum hydrocarbons at concentrations below the remediation goals in Table 7-11. No other organic COCs were detected in soil. VOCs were measured in groundwater samples, but at concentrations considerably less than the remediation goals in Table 7-11. VOCs detected in groundwater included chloroform at 5.3 μg/L, toluene at 0.9 μg/L, acetone at 35.4 μg/L, and 1,4-dichlorobenzene at 1.7 μg/L. Selected metals were present in soil and groundwater samples at ambient concentrations. These additional data confirm that Building 823 can be readily addressed by the protocols established in the RMP.

4.4.4.3.5 Potential Drum Drainage Area East of Buildings 805 and 806

USATHAMA (1988) identified the area adjacent to the Knight Railyard that is east of Buildings 805 and 806 as the specific location where Army personnel reportedly allowed damaged drums of chemicals to drain onto railroad track ballast in the past. The suspected area as depicted by USATHAMA (1988) is shown on Figure 4-11.

This potential drum drainage area identified by USATHAMA, as well as additional areas of potential drum drainage were investigated by the Army and OBRA and during the Phase II Investigations in April and May 2002. The results of the Phase II Investigations at the potential drum drainage areas are included in reports prepared by the Army (IT, 2002a) and OBRA (EKI, 2002).

The Army collected soil and groundwater samples within the area adjacent to the Knight Railyard that is east of Buildings 805 and 806. No evidence of chemical spillage in this area is suggested based on a review of the data obtained by the Army.

In an area south of the supposed drum drainage area, OBRA discovered a black tarry stain in shallow soil that smelled of petroleum hydrocarbons and solvents (EKI, 2002). Shallow soil samples collected at 0.5 to 1 foot bgs in this area contained petroleum hydrocarbons up to 3,600 mg/kg and related constituents that included 1,2,4-trimethylbenzene up to 33 mg/kg, 1,3,5-trimethylbenzene up to 9.6 mg/kg, ethylbenzene up to 6 mg/kg, total xylenes up to 37 mg/kg, propylbenzene up to 4.8 mg/kg, toluene up to 7.2 mg/kg, and naphthalene up to 17 mg/kg. The concentrations of all detected COCs were less than the health based remediation goals in Table 7-11. However, napthalene was measured at a concentration greater than the leaching based remediation goal in Table 7-11 but was not detected in groundwater.

COC impacts appear limited primarily to shallow soil. Only 1 of 3 soil samples collected at 3.5 to 4 feet bgs contained COCs. This soil sample contained 1,2,4-trimethylbenzene at 0.011 mg/kg and total xylenes at 0.0148 mg/kg. Trace concentrations of petroleum hydrocarbon constituents were detected in groundwater. COCs measured in groundwater samples included 1,2,4-trimethylbenzene at 6 μg/L, 1,3,5-trimethylbenzene at 2 μg/L, ethylbenzene at 2 μg/L, total xylenes at 14.2 μg/L, propylbenzene at 0.6 μg/L, and toluene at 6.5 μg/L. These relatively minor impacts can be readily addressed by the protocols established in the RMP.

4.4.4.3.6 Former Motor Pool and Salvage Operations at Building 640

World War II era maps of the OARB show a motor pool and salvage area existed in the area where Building 640 currently stands. The motor pool and salvage area included a gasoline station possibly with a UST, a motor repair shop, a paint spray booth, several grease racks and washracks, vehicle storage sheds, 1,535 feet of gasoline pipeline, and several salvage warehouses (BASELINE, 2002) (Figure 4-12). Review of Army historical records indicate these facilities were demolished and Building 640 was constructed by 1945.

The Army conducted sampling at the former motor pool and salvage operations area as part of its Phase II Investigation. PAHs and petroleum hydrocarbons were detected in soil at concentrations less than the remediation goals in Table 7-11. Organic COCs detected in groundwater included TPHd up to 150 μg/L, TPHmo up to 252 μg/L, and toluene, ethylbenzene, and xylenes at individual concentrations less than 1 μg/L. Selected metals were detected in soil and groundwater at ambient concentrations. These additional data indicate that the former motor pool and salvage operations area can be readily addressed by the protocols established in the RMP.

4.4.4.3.7 Benzidine at Former Used Oil Tank 21

Former used oil tank 21 was part of Facility 16, which was constructed in 1986 for preparing privately owned vehicles for overseas transport (IT, 2000i). Facility 16 also included a washrack and an oil/water separator. Used oil tank 21 was a UST situated partially beneath the washrack, which stored oil drained from vehicles before transport. Used oil tank 21, washrack, and oil/water separator were removed in December 1997. Excavation of contaminated soil discovered in the area was completed by March 1997 (Remedial Constructors, Inc., 1997). Figure 4-13 shows the boundaries of contaminated soil that was excavated. Soil beneath the former UST, following excavation of contaminated soil, contained residual concentrations of lead, PAHs, and petroleum hydrocarbons, which are COCs typically associated with used oil releases.

Besides typical used oil constituents, benzidine was reportedly measured at 48 mg/kg in soil remaining beneath the former UST, and at 6.3 mg/kg in stockpiled soil removed from the excavation pit. The Army disposed of the stockpiled soil at an off-site, permitted waste management facility. Benzidine is not typically found in used oil and its detection at this former tank location is unusual. The United States Department of Health and Human Services, Agency for Toxic Substances and Disease Registry ("ATSDR"); (1995b) states that benzidine was used primarily to produce dyes for cloth, paper, and leather. Benzidine has not been manufactured for sale in the United States since the mid-1970s. Major dye companies in this country no longer make dyes that have benzidine as an ingredient given concerns about the potential carcinogenic effects of the chemical.

Testing by the Army after completing excavation activities at former used oil tank 21 did not detect benzidine in soil or groundwater, but analytical method reporting limits of collected samples were higher than concentrations at which benzidine is considered to be a potential human health risk. Thus, additional sampling as described in the RMP will be performed at the former used oil tank 21 area.

4.4.4.4 Historical Spills and Stains

Review of Army documents and historical aerial photographs indicate that numerous spills and stains have been observed over the years at the OARB. Possible chemical releases range from stained pavement caused by minor leakage from parked vehicles to spills of hazardous substances. Figure 4-14 depicts the locations where spills and stains have been historically observed or noted. As part of its Phase II Investigation, the Army investigated some of the locations where spills and stains were observed. PAHs and petroleum hydrocarbons were detected at concentrations less than the remediation goals in Table 7-11. These additional data indicate that the locations of historical spills and stains can be readily addressed by the protocols established in the RMP.

Historical spills and stains are considered to be a basewide RMP issue. As a consequence, soil excavated during new construction will be inspected for contamination. Protocols for inspecting and managing contaminated soil during and after redevelopment are specified in the RMP.

4.4.4.5 Lead in Soil Around Buildings

Federal statutes define paint to be lead-based if it contains lead at concentrations greater than 1.0 mg/cm^2 or 5,000 mg/kg. However, paint manufactured before 1978 may still contain significant amounts of lead even if does not meet the federal definition of LBP (United States Department of Housing and Urban Development, 1995). The EBS identified the buildings that may contain LBP based upon the age of construction.

ACE (1997a) conducted a LBP investigation of buildings at the OARB. Figure 4-15 shows the buildings that tested positive and those that tested negative for LBP. Also depicted on this figure are the structures that possibly contain LBP given their age of construction listed in the EBS but were not included in the LBP investigation by ACE. Figure 4-15 also presents lead analytical results for samples collected by the Army within the upper two feet of soil near buildings, and indicates the areas near buildings where shallow soil (i.e., from ground surface to 2 feet bgs) is suspected to be impacted by lead. Requirements for managing shallow soil known or suspected to contain LBP at the OARB are incorporated into the RMP.

As part of its Phase II Investigation, OBRA collected 60 additional shallow soil samples around the perimeter of buildings that had painted surfaces that tested positive for LBP, or possibly contain LBP based on the building age of construction. These data are not depicted on Figure 4-15 but are provided in Appendix A. Lead concentrations greater than 350 mg/kg were measured in 7 of 60 samples, and lead concentrations greater than 100 mg/kg were measured in 39 of 60 samples. The maximum lead concentration detected in the shallow soil samples was 1,000 mg/kg. These analytical results confirm that shallow soil near buildings that contain LBP can be addressed by the protocols in the RMP for managing shallow soil known or suspected to contain lead.

4.4.4.6 Former PCB-Containing Transformers and Equipment Locations

The PA/SI and the utility survey conducted by EarthTech for the City of Oakland include inventories of PCB-containing transformers and equipment at the OARB. These inventories list approximately 110 pieces of electrical transformers or other equipment that may have contained, or still contain, PCBs. Requirements for managing PCB-containing transformers, equipment, and underlying soils at the OARB are incorporated into the RMP. The management of PCB-containing equipment, and the remediation of PCB-impacted media, must also meet the requirements of TSCA, which is administered by U.S. EPA.

4.4.4.7 Storm Drains and Sanitary Sewers

Reports prepared by the Army indicate that the storm drain system at the OARB consists of 107,484 linear feet ("lf") of pipe (ICF Kaiser Engineers, Inc., 1999a). The storm drains convey water to San Francisco Bay through 13 outfalls (Figure 4-16). Most water discharged from the outfalls appears to originate from the OARB with one notable exception. Outfall 8b receives large flows from the City of Oakland through a 36-inch diameter storm drain that enters the OARB from West Grand Street and through a 42-inch diameter storm drain from the nearby EBMUD wastewater treatment plant (EarthTech, 2000a). The alignments of these two regional storm drains are depicted on Figure 4-16.

The sanitary sewer system consists of approximately 25,000 lf of pipe (ICF Kaiser Engineers, Inc., 1999a). Four pump or lift stations located throughout the OARB convey sewage to the EBMUD wastewater treatment plant. The flat topography of the OARB prevents sewage from flowing by gravity to the EBMUD plant (EarthTech, 2000a).

Several studies (EarthTech, 2000a; ICF Kaiser Engineers, Inc., 1999a; Radian, 1997a, 1997b) indicate that both the storm drain and sanitary sewer systems are in poor condition. Video camera inspections have been conducted of portions of the storm drain and sanitary sewer systems that lie north of 14th Street. These prior inspections reveal that approximately 45 percent of the storm drain pipe and 60 percent of the sanitary sewer pipe that have been examined have defects. Defects are defined as pipe with sags; plant root intrusion; sections that have cracked, developed holes, or collapsed; or joints that have separated or become misaligned. Moreover, EarthTech (2000a) notes that the exceptionally flat grades of the storm drain and sanitary sewer systems allow sediments to accumulate and block the insides of pipes.

Sediment from storm drains on the OARB has likely been discharged to San Francisco Bay in the past. It is unknown if such discharge is ongoing because improvements in storm water management practices (e.g., periodic removal of sediments from catch basins, better chemical handling, and reductions in the frequencies of chemical spills) have likely decreased the sediment and contaminant quantities that are transported through the storm drains.

Sediment that builds up in the catch basins or inlets to the storm drains is periodically removed (ICF Kaiser Engineers, Inc., 1999a). Previous testing of this sediment by the Army revealed that some sediment contained petroleum hydrocarbons, PAHs, lead, and other metals that are reflective of road grime, which likely washes into the catch basins. PCBs and pesticides have occasionally been detected in the sediment.

OBRA tested sediment in storm drain piping as part of its Phase II Investigation. This testing indicates that sediment in portions of the storm drain piping still contain petroleum hydrocarbons, PAHs, lead and other metals, as well as low concentrations of PCBs and pesticides. No COCs were detected at concentrations that would qualify the sediment as a principal threat waste, as described in Section 8.1. The past presence of contaminants in storm drains and sanitary sewer systems combined with breaches in the pipes of these systems may have allowed COCs to leak into soil and groundwater that surround the pipes. However, based on its investigative findings, ICF Kaiser Engineers, Inc. (1999a) concluded that only localized contamination in soil and groundwater exists near storm drains and sanitary sewers. Figure 4-16 indicates the generalized areas where such contamination has been identified to date.

EarthTech evaluated the storm drain and sanitary sewer systems to determine their compatibility with planned redevelopment of the OARB. EarthTech (2000a) finds that both systems will have to be almost completely replaced because they are in poor condition, undersized, and configured in a manner that conflict with the footprint of new construction. The EIR states that infrastructure replacement will be accomplished over a period of five years following base transfer. It is anticipated that the localized soil and groundwater contamination associated with existing storm drains and sanitary sewers described in Army reports can be adequately addressed through implementation of protocols in the RMP as part of infrastructure replacement, as redevelopment proceeds.

4.4.4.8 Railroad Tracks

Approximately 26 miles of railroad track remain at the OARB (Figure 4-17). In addition, former railroad track ballast is covered with imported gravel in the former Baldwin Railyard. According to U.S. EPA (2001d, 1997b), typical contamination in old railyards such as those that exist at the OARB can include:

- Petroleum hydrocarbons from spillage during fueling operation and repetitive minor leakage from engines and rail cars.
- PCBs from the hydraulic systems of locomotive engines and electrical equipment.
- Metal and asbestos dust from brake shoes and other friction sources.
- Solvents, BTEX, and other VOCs.

Surface soil in railyards may also become contaminated with creosote, pentachlorophenol ("PCP") or chromated copper arsenate ("CCA") that originate from preservatives that are often applied to railroad ties (Felton and DeGroot, 1996; U.S. EPA, 1993a). Herbicides sprayed near tracks for weed control may also be present.

To investigate the possibility of such contamination of track areas at OARB, OBRA collected 38 subballast samples beneath railroad tracks as part of its Phase II Investigation. Subballast at the OARB is a sand layer that comprises the interface between the rock ballast placed between railroad ties and the underlying fill imported to construct the OARB. Benzo(a)pyrene was detected at concentrations greater than its remediation goal in Table 7-11 in 4 of 38 subballast samples. Other COCs detected in the subballast included petroleum hydrocarbons at a maximum concentration of 680 mg/kg, PCP at a maximum concentration of 3.8 mg/kg, and PCBs at a maximum concentration of 0.13 mg/kg. petroleum hydrocarbons, PCP, and PCB concentrations measured in the subballast samples were less than the remediation goals in Table 7-11.

Metals detected in the subballast included arsenic at a maximum concentration of 24 mg/kg, total chromium at a maximum concentration of 280 mg/kg, and lead at a maximum concentration of 470 mg/kg. During the OBRA Phase II investigation, only arsenic in one subballast sample was detected greater than its remediation goal. These results indicate that subballast beneath railroad tracks can be readily addressed by the protocols established in the RMP.

4.4.4.9 Marine Sediments

The Army has identified COC impacts to marine sediments near storm drains from the portions of the OARB (i.e., those at former BRAC Parcels 2 and 3) being transferred via the EDC. These storm drains, including Outfalls 5 through 11, are shown on Figure 4-16 and discharge to the Oakland Outer Harbor in San Francisco Bay. Marine sediments at Outfall 4 are defined to be part of the "Spit" that is not being transferred via an EDC, but instead proposed for a PBC transfer to DOI and then EBRPD. The "Spit" and associated Outfall 4 are, thus, not considered in this RAP. The Army concluded that sediments at Outfalls 5 through 7 are "are unlikely to result in unacceptable adverse effects on aquatic or wildlife receptors" (Harding ESE, 2002).

Metals, PAHs, pesticides, and PCBs have been detected in marine sediments at Outfalls 8 through 11 (Harding ESE, 2002). Maximum metal concentrations detected in marine sediments at Outfalls 8 through 11 include arsenic at 19.9 mg/kg, cadmium at 3.52 mg/kg, copper at 97.5 mg/kg, lead at 1,850 mg/kg, mercury at 1.03 mg/kg, selenium at 1.93 mg/kg, silver at 1.09 mg/kg, and zinc at 579 mg/kg. Maximum organic COC concentrations detected in marine sediments at Outfalls 8 through 11 include dieldrin at 790 μg/kg, total DDT isomers at 803 μg/kg, total PAHs at 190 mg/kg, and PCBs at 790 μg/kg. The Army (Harding ESE, 2002) concluded from its ecological risk assessment that "sediments at Outfalls 8 through 11, if not capped in the future, may result in limited impacts to aquatic communities." The Port of Oakland intends to fill 26 acres to provide additional terminal capacity and create two berths in the Oakland Outer Harbor as outlined its Seaport Plan for 2020 (Harding ESE, 2002). The Port of Oakland's berth expansion project, when implemented, will result in covering the marine sediments adjacent to Outfalls 8 through 11, thereby addressing potential impacts identified by the Army's ecological risk assessment.

4.4.4.10 Shallow Groundwater

Data collected to date indicate that chemical impacts to shallow groundwater appear to be limited to a few areas of the shallow water-bearing zone that are entirely within the boundary of the OARB. These impacted areas are identified as RAP groundwater sites, or RMP locations.

As discussed in Section 4.3.5, the Army and OBRA performed Phase II Investigations of the OARB in May 2002. As part of these activities, the Army and OBRA collected a total of 77 groundwater samples from 15 permanent monitoring wells and 62 temporary wells and borings (EKI, 2002; IT, 2002a). Twelve of the monitoring wells are located along the perimeter of the OARB in the downgradient direction of groundwater flow in the shallow water-bearing zone (Figure 4-18).

Groundwater samples were collected from new permanent monitoring wells using low-flow sampling techniques and were analyzed for a suite of organic COCs and metals. Analytical results for groundwater samples collected from monitoring wells are shown on Figure 4-18 and in Table 4-5. Groundwater samples for metals analysis obtained from temporary wells and borings were field filtered. Analytical results for groundwater samples collected from temporary wells and borings are included in Table 4-5.

The Army and OBRA Phase II Investigation data as shown on Figure 4-18 and in Table 4-5 indicate that only the RAP groundwater sites have definable impacts, i.e., plumes, of organic COCs in shallow groundwater (EKI, 2002; IT, 2002a). The RAP groundwater sites consist of isolated areas of vinyl chloride, petroleum hydrocarbons, and related constituents in groundwater in the shallow water-bearing zone that are entirely within the boundary of the OARB. The Phase II Investigation data confirm that organic COCs are not migrating in groundwater from these RAP sites to San Francisco Bay.

Arsenic, manganese, and thallium were the only metals detected in the Phase II Investigation groundwater samples at concentrations greater than U.S. EPA Region IX Preliminary Remediation Goals ("PRGs") for tap water, which were used for reference only (EKI, 2002; IT, 2002a). As shown on Figure 4-18 and in Table 4-5, none of these metals are present in groundwater as definable plumes. As discussed below, these metals do not appear related to chemical releases to soil or groundwater.

Kleinfelder (1998a) concluded that one reason COCs have not migrated far from the suspected points of release is the groundwater velocity is low compared with the rate of sorption and degradation mechanisms. In other words, the COC distributions in the shallow water-bearing zone at the RAP groundwater sites appear to be at steady state. The advective movement of COCs in groundwater is counterbalanced by the rate at which COCs are removed from groundwater by sorption and degradation mechanisms. While plausible, this phenomenon has not been confirmed and will require further evaluation as part of the 5-year review.

4.4.4.10.1 Manganese in Groundwater

Manganese was detected in all 77 groundwater samples collected as part of the Army and OBRA Phase II Investigations and analyzed for manganese. Manganese concentrations ranged from 6.6 to 12,400 µg/L with an arithmetic mean of 1,290 µg/L. No water quality criterion for manganese has been established in either the *Water Quality Control Basin Plan, San Francisco Bay Basin* ("Basin Plan"); (RWQCB, 1995) or Title 40 of the Code of Federal Regulations ("CFR") §131.38, *Establishment of Numerical Criteria for Priority Toxic Pollutants for the State of California*, also known as the California Toxics Rule ("CTR").

The concentrations of manganese detected in groundwater at the OARB likely result from dissolution of naturally occurring manganese in soil due to the creation of local reducing conditions caused by natural organic matter (see for example Drever, 1982). Natural organic matter is present in the shallow water-bearing zone at the OARB, which is a historically filled area of organic rich mud flats. Manganese in groundwater is indicative of mildly reducing conditions.

Manganese concentrations in groundwater samples collected as part of the Phase II Investigations are directly comparable to manganese concentrations collected from porewater in nearshore sediments elsewhere in San Francisco Bay (Rivera-Duarte and Flegal, 1994). Manganese was detected by Rivera-Duarte and Flegal in 38 of 40 submerged sediment porewater samples collected at four nearshore locations. Summarized below are the minimum, maximum, and arithmetic mean manganese concentrations calculated for groundwater samples collected as part of the Phase II Investigation and those reported by Rivera-Duarte and Flegal (1994) for San Francisco Bay porewater:

Data Source	Minimum Manganese Concentration (µg/L)	Maximum Manganese Concentration (µg/L)	Arithmetic Mean Manganese Concentration (µg/L)
OBRA and Army Phase II Groundwater Samples (EKI, 2002; IT, 2002a)	6.6	12,400	1,290
San Francisco Bay Porewater Samples (Rivera-Duarte and Flegal, 1994)	5	13,000	1,700

These available data suggest that manganese in groundwater at the OARB is naturally occurring and not a threat to the environment.

Further, available metals data for soil do not indicate that a release of manganese to soil at the OARB has occurred. The Army calculated the ambient concentration for manganese in soil at the OARB to be 960 mg/kg (Table 5-1). Although manganese was detected in all 87 soil samples collected by OBRA in its Phase II Investigation at concentrations ranging from 53 to 1,400 mg/kg, only three soil samples had reported manganese concentrations greater than the ambient concentration. One of these samples contained manganese at 1,400 mg/kg and the other two samples contained manganese at 1,000 mg/kg. The arithmetic mean concentration of manganese in soil samples obtained as part of OBRA's Phase II investigation is approximately 500 mg/kg.

The absence of manganese contaminated soil coupled with the fact that manganese concentrations in groundwater at the OARB are similar to ambient San Francisco Bay sediment porewater concentrations indicate that manganese in the shallow water-bearing zone at the OARB is naturally occurring and not due to chemical releases.

4.4.4.10.2 Arsenic in Groundwater

Arsenic was detected in 46 of the 77 groundwater samples that were collected as part of the Phase II Investigations and analyzed for arsenic. The arithmetic mean arsenic concentration was 11 µg/L. The arsenic water quality criterion for protection of ecological receptors in the Basin Plan (RWQCB, 1995) and the CTR is 36 µg/L (continuous concentration, i.e., 4 day average, for saltwater aquatic organisms.) Arsenic concentrations in 75 of the 77 Phase II Investigation groundwater samples were less than the arsenic water quality criterion of 36 µg/L. In the other two samples, arsenic concentrations only slightly exceeded this water quality criterion with reported concentrations of 37 µg/L and 43 µg/L. This comparison is for reference only in as much as the criterion applies to arsenic in surface water that directly contacts ecological receptors or aquatic organisms and not to groundwater within the upland areas of the OARB.

Arsenic in groundwater at the OARB is likely a result of dissolution of naturally occurring arsenic in soil under reducing conditions that appear to exist at the OARB. Arsenic concentrations in groundwater collected as part of the Army and OBRA Phase II Investigations are comparable to ambient (i.e., unimpacted) arsenic concentrations measured in other nearshore East San Francisco Bay groundwater (EKI, 1998). Summarized below are the minimum, maximum, and arithmetic mean arsenic concentrations calculated for groundwater samples collected as part of the Phase II Investigation and those reported by EKI (1998) for nearshore East San Francisco Bay groundwater:

Data Source	Minimum Arsenic Concentration (µg/L)	Maximum Arsenic Concentration (µg/L)	Arithmetic Mean Arsenic Concentration (µg/L)
OBRA and Army Phase II Groundwater Samples (EKI, 2002; IT, 2002a)	1.1	43	11
Nearshore East San Francisco Bay Groundwater (EKI, 1998)	7.8	15	11

These Phase II Investigation data suggest that arsenic in groundwater at the OARB is naturally occurring, generally below, or only slightly greater than the potentially applicable arsenic aquatic water quality criterion in the Basin Plan (RWQCB, 1995), and not a threat to the environment.

The Army calculated the ambient concentration for arsenic in soil at the OARB to be 17 mg/kg (see Table 5-1). Arsenic was detected in all 98 soil samples collected by OBRA in its Phase II Investigation at concentrations ranging from 0.43 to 36 mg/kg. Only 5 out of 98 soil samples collected by OBRA had arsenic at concentrations somewhat greater than the ambient concentration. The arithmetic mean concentration of arsenic in soil samples obtained as part of OBRA's Phase II investigation is approximately 5.8 mg/kg. However, other data previously collected by the Army identified specific locations where arsenic concentrations in soil exceeded 34 mg/kg and were detected at concentrations up to 101 mg/kg. These concentrations and the tight spatial grouping of the elevated results indicate possible localized releases of arsenic near storm drains and railroad tracks that may require further investigation and remediation, as discussed later in this RAP.

Thus, the absence of arsenic contaminated soil, except possibly in localized areas noted above, coupled with the fact that arsenic concentrations in groundwater at the OARB are similar to ambient concentrations at other nearshore East San Francisco Bay locations indicates that arsenic in the shallow water-bearing zone at the OARB is naturally occurring and not due to chemical releases.

4.4.4.10.3 Thallium in Shallow Groundwater

Thallium concentrations reported in groundwater samples collected by the Army in its Phase II Investigation and in groundwater samples that have been obtained previously by others are most likely false positives and do not reflect the actual presence of thallium in groundwater above analytical method reporting limits. Thallium analysis by Inductively Coupled Plasma ("ICP"), U.S. EPA Method 6010B, can produce false positive determinations due to spectral interferences. U.S. EPA (1997h) states the following in *Test Methods for Evaluating Solid Waste* ("SW 846") regarding the effect of spectral interferences on thallium analytical results:

> When operative and uncorrected, interferences will produce false positive determinations and be reported as analyte concentrations.

SW 846 lists aluminum as a common interfering compound in the ICP analysis for thallium. Thallium false positives typically display these characteristics:

- No probable source for thallium contamination exists.

- Analysis for thallium was by ICP, not graphite furnace atomic absorption or Inductively Coupled Plasma–Mass Spectrometry ("ICP-MS"), U.S. EPA Method 6020.

- The data are usually produced by a single laboratory analyzing samples from a single sampling event and are often confined to a single analytical batch.

- Re-sampling and/or reanalysis, particularly by ICP-MS, do not confirm the original data.

Groundwater samples collected by OBRA in its Phase II Investigation were analyzed for metals using ICP-MS. No groundwater samples collected as part of OBRA's Phase II Investigation were reported to contain thallium above analytical method reporting limits. Thus, thallium is judged not to be a contaminant of concern in shallow groundwater at the OARB.

5

5. COC IDENTIFICATION

U.S. EPA (1989d) and DTSC (1996) recommend that all chemicals detected in soil, groundwater, or other impacted media be retained as chemicals of concern ("COCs"), if feasible. However, approximately 140 different chemicals have been measured in soil, and approximately 110 different chemicals have been measured in groundwater at the OARB. Many of these chemicals have been infrequently detected at extremely low concentrations. Attempts to calculate and apply risk-based remediation goals for all these chemicals would prove cumbersome and would not provide any true additional protection against exposure to residual chemicals at the OARB. Therefore, chemicals reported in soil and groundwater samples were screened to identify COCs in impacted media that contribute to potential human health risks at OARB BRAC property to be transferred to OBRA.

As described in Section 5.2, U.S. EPA (1989d) screening protocols were employed to identify COCs in soil and groundwater at the OARB. These screening protocols resulted in retaining all metals regulated under 22 CCR §66261.24 ("Title 22 metals"), as well as numerous other chemicals, as COCs in soil and groundwater.

5.1 ASSESSMENT OF DATA QUALITY AND REPRESENTATIVENESS

The quality and representativeness of analytical results contained in the database for the OARB was assessed before screening data to identify COCs. Based on the outcome of this assessment, certain analytical results were not considered in determining COCs because the analytical results were not pertinent or otherwise not representative of current environmental conditions of property being transferred to OBRA via the EDC.

The Army provided OBRA with an electronic database for the OARB in March 2002 (IT, 2002b). This computerized database contained approximately 204,000 records of analytical results. These soil, water, and air samples were collected primarily by the Army between 1989 and January 2002. The analytical results of the Phase II Investigations will be incorporated into the database when the analytical results are fully available in an electronic format. The database will be maintained and periodically updated with new analytical results as specified in the RMP.

The City understands that the Army March 2002 database includes analytical results from the following sources among others:

- RI data compiled by SCS Engineers in 1991, 1993, and 1994; ICF Kaiser Engineers in 1998, 1999, and 2000; and IT Corporation in 2001 and 2002

- Monitoring well groundwater data compiled by ICF Kaiser Engineers from 1998 to 2000, and IT from 2000 to 2002

- Confirmation sampling data compiled by SCS Engineers in 1996 associated with former tank locations

- Sampling data compiled by Caltrans in 1994 associated with reconstruction of the I-880 freeway

- Sampling data compiled by AAFES in 1996 associated with a Phase II investigation of part of the OARB

EKI assessed the quality and representativeness of the analytical results contained in the database for relevance to this RAP. This assessment was performed in two steps. The first step entailed identifying and excluding analytical results for samples that are clearly not germane to understanding current environmental conditions of the BRAC property being transferred to OBRA. The second step also involved eliminating non-representative analytical results, but entailed more careful evaluation and a greater degree of professional judgment than the first step before deciding certain analytical results were not valid for the purpose of identifying COCs. To preserve the integrity of the database, analytical results "removed" in these screening steps were not actually purged from the database, but rather "flagged" so that appropriately stated queries regarding COCs would not include these analytical results unless specifically sought. OBRA's edited database that resulted from screening is referred to as the "COC database" and contains data collected primarily by the Army from 1989 through January 2002. An electronic copy of the COC database is contained on the compact disc included as Appendix A. Analytical results of the OBRA and Army Phase II Investigations are contained in separate reports (EKI, 2002; IT, 2002a) and are also included in Appendix A as separate data files.

5.1.1 Exclusion of Non-Pertinent Data

Data excluded in the first screening step consisted of non-detected chemicals, inorganic chemical and parameters unrelated to anthropogenic releases, analytical results associated with samples from non-pertinent media, analytical data from soil that has been excavated or from property not subject to this RAP, and sample analytical results that are unreliable or have been rejected during validation as discussed below.

5.1.1.1 Non-Detected Chemicals

Chemicals were generally excluded from the COC database when all analytical results for soil and groundwater samples were below laboratory reporting limits, unless the chemical was expected based on previous site use or the chemical was detected in other media sampled at the site. Non-detected chemicals retained as COCs consist of the following:

- Thallium in soil at the former ORP because this chemical is a Title 22 metal and was detected in soil outside the former ORP / Building 1 area.
- Cadmium and beryllium in groundwater at the former ORP because these chemicals are Title 22 metals and were detected in groundwater outside the former ORP / Building 1 area.
- Dibromochloromethane, 1,1,2-trichloroethane, 1,1-dichloroethane, and 1,2-dichloroethane in soil because these chemicals were detected in groundwater.
- Toxaphene in soil because other pesticides are COCs at the OARB and the laboratory reporting limits for toxaphene were greater than criteria used to screen infrequently detected chemicals.

5.1.1.2 Inorganic Chemicals and Parameters Unrelated to Anthropogenic Releases

Many inorganic chemicals are major components of the Earth's crust. Data on inorganic chemicals that are essential nutrients or trace elements present at normal crustal abundance levels were excluded from the COC database. These excluded inorganic chemicals consisted of: aluminum, calcium, iron, magnesium, potassium, sodium, strontium, and titanium. Groundwater parameters (i.e., alkalinity, hardness, carbonate, conductivity, dissolved and total solids, pH, surfactants, and turbidity) were also excluded from the COC database. While such data may prove useful for evaluation of remedial alternatives or design of engineering controls, these data were not considered in the identification of COCs.

5.1.1.3 Samples Collected from Property Not Subject to RAP

Data associated with property not subject to this RAP were excluded from the COC database. Data for the following areas of the OARB or adjacent properties were not used to identify COCs:

- "Spit," which the Army identified as BRAC Parcel 1.
- Submerged marine sediments in the Oakland Outer Harbor.
- Army Reserve parcels, which comprised Army BRAC Parcels 6, 7, and 18; and portions of BRAC Parcels 19 and 21.
- Off-site wetlands located east of Building 991 included in former Army OU2.
- Any other impacted off-site areas (e.g., debris that may extend onto existing Port of Oakland land west of Building 99).

For analytical results of these media, a data flag was set to "armyreserve" or "offsite" in a data field called "samplestatus" that was added to the IT electronic database. These flags were used to exclude analytical results of the above areas when screening the database for COCs.

5.1.1.4 Non-Representative Media

Various sampling matrices are identified in the IT database. Sample matrix information is indicated in the "s_matrix_d" data field. Based upon the nomenclature provided in the IT database, analytical results of samples from the following media were excluded from the COC database because none of these media types are considered relevant to chemicals remaining in soil and groundwater at RAP sites and RMP locations addressed in this RAP / RMP:

- 11 ambient air samples
- 7 sediment samples from within storm drains
- 68 marine sediment samples [12]

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[12] The Army has separately evaluated the ecological risks of marine sediments associated with former BRAC Parcels 2 and 3. Refer to Section 4.4.4.9 for a discussion of these marine sediments.

- 1 sediment sample from the interior of a sump
- 1 soil or solid sample of unknown origin
- 11 plant or animal tissue samples
- 5 water samples from storm drain outfalls to San Francisco Bay
- 9 drilling water samples
- 164 equipment rinse water samples
- 238 trip blank samples
- 19 tap water samples
- 3 seawater samples
- 16 samples obtained for classification and disposal of wastes

Although analytical results of the above media types may aid in future evaluation of certain environmental issues (e.g., submerged marine sediments, storm drain contents), the data are not pertinent to RAP sites and RMP locations subject to this RAP / RMP, and these data were not considered in the identification of COCs.

5.1.1.5 Soil That Has Been Excavated

Analytical results of soil that was subsequently excavated as part of remedial activities, which could be verified through review of Army documents, were excluded from the COC database. Analytical results of residual chemical concentrations in soil after excavation (i.e., confirmation samples) were kept in the COC database. A flag in the "samplestatus" data field was set to "excavated" to exclude analytical results of excavated soil from the COC database. Analytical results were retained in the COC database if there was any uncertainty regarding whether the sampled soil had been excavated.

5.1.1.6 Special Analytical Methods

Data that were generated by special laboratory methods or tests unrelated to in-situ soil and groundwater conditions at the OARB were excluded from the COC database. Such data eliminated were analytical results of the Toxicity Characteristic Leaching Procedure ("TCLP") and other tests related to waste disposal classification or chemical mobility in soil.

5.1.1.7 Unreliable or Rejected Data

Data flagged as "R" in the "epaflags" data field in the IT database are assumed to be unreliable or previously rejected by the Army as a result of its quality assurance / quality control ("QA / QC") evaluation. These flagged data were excluded from the database before screening for COCs for the RAP.

5.1.2 Exclusion of Non-Representative Data

Certain analytical results remaining in the database after completing the first screening step, as described above, were determined to be non-representative of COCs currently found in soil or groundwater at RAP site and RMP locations and were excluded from the COC database. Exclusion of analytical results during this second step was based upon more detailed evaluation and greater degree of professional judgment.

5.1.2.1 Common Laboratory Contaminants

Acetone, methyl ethyl ketone, methylene chloride, and phthalate esters are recognized as common laboratory contaminants (DTSC, 1999; U.S. EPA, 1989e). According to U.S. EPA screening protocols (1989d), common laboratory contaminants can be excluded from the COC database if the maximum concentrations detected in the environmental samples are less than 10 times the maximum concentrations detected in any blank sample. For conservatism, all chemicals that can be considered common laboratory contaminants were retained as COCs in soil and groundwater. A more detailed evaluation should be conducted if potential laboratory contaminants govern the need for future remediation at RAP sites or RMP locations.

5.1.2.2 Anomalous Cyanide Concentrations in Soil

A batch of soil samples collected from borings for monitoring wells BB-1 through BB-6 had reported concentrations of 0.15 to 15.1 mg/kg of cyanide. The cyanide analytical results are believed to be "false positives." The samples were tested for cyanide in the laboratory as a single batch by U.S. EPA Method 9010, which is a colorimetric method that is prone to interference caused by natural organic matter and other compounds in soil that may lead to erroneous results (U.S. EPA, 1997h). No current or former metal plating operations, which are a common source of cyanide, have been identified at the OARB. Further, the soil samples from these borings were collected during one sampling event at several different areas of the OARB. Although rarely included as an analyte, cyanide has not been detected in any other soil or groundwater samples obtained at the OARB.

Exclusion of data from borings for monitoring wells BB-1 through BB-6 eliminated cyanide from the COC database.

5.1.2.3 Metal Analytical Results from Unfiltered Groundwater Samples

As discussed in Section 4.3.2, laboratory analysis of unfiltered groundwater samples with high turbidity (i.e., greater than 5 NTU) are not likely to produce representative concentrations of dissolved metals in groundwater. Consistent with U.S. EPA (1997c, 1995a) and DTSC (1999) guidance, only analytical results of unfiltered groundwater samples with low turbidity (i.e., less than 5 NTU) or groundwater samples passed through an in-line filter are considered representative of concentrations of metals dissolved in groundwater at the OARB.

Unfortunately, the structure of the IT database does not allow for easy identification or determination of metal analytical results of unfiltered groundwater samples with high turbidity. Therefore, all unfiltered and filtered groundwater metal data were kept in the database for purposes of identifying chemicals to be retained as COCs. However, summary statistics on metal concentrations in groundwater were not calculated because such statistics are not representative of dissolved concentrations due to artificially high concentrations of metals measured in unfiltered groundwater samples with excessive turbidity. For example, the reported maximum concentration of arsenic in unfiltered groundwater samples is 4,930 μg/L, as compared with a reported maximum concentration of 82.6 μg/L for those samples that were filtered. All Title 22 metals were identified as COCs in groundwater.

5.2 SCREENING OF REMAINING DATA TO IDENTIFY COCs

Upon excluding non-pertinent and non-representative data as described in Sections 5.1.1 and 5.1.2, the database was further screened to identify COCs for: (1) the former ORP / Building 1 area, and (2) for the remainder of BRAC property at the OARB subject to this RAP. COCs were identified separately for the former ORP / Building 1 area because the tarry residue at this RAP site is fundamentally different from the types of contaminants found elsewhere at the OARB. Refer to Section 4.4.3.1 for a summary of the former ORP / Building 1 area use history and description of the tarry residue.

5.2.1 Ambient Metal Concentrations in Soil

Remediation of metal releases to concentrations that are below ambient concentrations (i.e., background levels) in soil is not intended by U.S. EPA (1992b, 1989d) or DTSC

(1999). Reported concentrations of metals in soil were compared with ambient levels to distinguish metals that may originate from a release and from those that exist at ambient levels and do not require remedial actions.

If possible, ambient metal concentrations in soil were determined based on the Army's statistical analysis of data for background soil samples collected at the OARB. Ambient background levels of metals derived from the statistical analysis are presented in ICF Kaiser Engineers' *Attachment A to the Risk Assessment Work Plan, Ambient Data Analysis for Soil, Oakland Army Base, California*, (ICF, 1999e). Because the Army did not derive ambient levels for silver and thallium, naturally occurring concentrations for silver and thallium in soil reported by Lawrence Berkeley National Laboratory ("LBNL"); (1995) were assumed. Metals in the database were compared with the ambient levels compiled in Table 5-1. All Title 22 metals in soil were retained as COCs based upon the results of this comparison.

5.2.2 Infrequently Detected Chemicals Below Risk-Based Screening Levels

Many chemicals in the COC database are rarely detected. Regarding the infrequent detection of chemicals, U.S. EPA (1989d) states that:

> Chemicals that are infrequently detected may be artifacts in the data due to sampling, analytical, or other problems, and therefore may not be related to site operations or disposal practices. Consider the chemical as a candidate for elimination from the quantitative risk assessment if: (1) it is detected infrequently in one or perhaps two environmental media, (2) it is not detected in any sampled media or at high concentrations, and (3) there is no reason to believe that the chemical may be present.

U.S. EPA risk assessment guidance was followed to establish the minimum frequency level for chemical detection. As suggested by U.S. EPA (1989d, 1989e), an infrequently detected chemical at RAP sites and RMP locations was determined to be a chemical that was detected in less than 5 percent of the samples for which it was analyzed.

As suggested by the U.S. EPA (1989d), infrequently detected chemicals with maximum concentrations less than screening levels were excluded from the COC database if the chemicals were not believed to be plausibly associated with chemical releases at the OARB. Screening levels consisted of U.S. EPA (2000b) Region IX PRGs for residential land use for chemicals detected in soil and MCLs or U.S. EPA (2000b) Region IX tap water PRGs, if no MCLs have been promulgated, for chemical detected in groundwater.

These screening levels were intended to be a conservative evaluation of human health risk.[13]

Screening of infrequently detected chemicals was performed with caution in recognition of the fact that not all potentially complete exposure pathways are included in calculation of U.S. EPA PRGs and that exposure to multiple chemicals in several media are not assumed in U.S. EPA PRGs.[14] Consequently, the screening was applied with judgement. Several VOCs (e.g., TCE, vinyl chloride, cis-1,2-DCE, trans-1,2-DCE), although infrequently detected in soil at concentrations below screening levels, were retained as COCs because the chemicals are still present in groundwater and may be found at measurable concentrations in soil during future sampling at the OARB.

The former incinerator (Building 147) that was situated along the northern boundary of the OARB (Figure 4-1) illustrates the importance of the use histories on understanding the detection frequencies of PCDDs and PCDFs. The Army collected two soil samples in the vicinity of this former incinerator and analyzed the samples for dioxin-like compounds because PCDDs and PCDFs can be formed as a by-product of combustion. Historical information indicating that the incinerator had never been used apparently had not been reviewed at the time the Army performed this sampling. PCDDs and PCDFs were measured at low concentrations in one of these two samples, which equates into a detection frequency of 50 percent. Strict adherence to the 5 percent frequency level would result in retaining dioxin as COCs in soil. However, PCDDs and PCDFs found at low concentrations in this single sample likely reflect trace deposition from regional sources (e.g., diesel-powered vehicles traveling the nearby I-80 freeway) as opposed to activities or significant releases at the OARB.[15] The incinerator (Building 147) is a case in point. The incinerator was built but never used. In a memorandum, dated 25 March 1964, the Army (1965) states:

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[13] Background metal levels, U.S. EPA residential and tap water PRGs, and MCLs are too stringent to be considered appropriate site-specific remediation goals given the brackish groundwater and planned commercial and industrial uses of the OARB. However, use of screening levels that are based upon consumption of drinking water and residential use provides a sufficient degree of conservatism that it can be concluded with confidence that maximum detected concentrations of chemicals less than these screening levels do not pose appreciable human health risks at the OARB now or in the future.

[14] Taking into account the planned commercial and industrial uses of the OARB, vapor intrusion into buildings is the most significant exposure pathway not included in calculation of U.S. EPA PRGs. Refer to Section 7.3.2.1 for a discussion of how this potential exposure pathway relates to the OARB.

[15] Growing concern over widespread ambient levels of dioxins has led the Association of Bay Area Governments (2001) to study means of reducing PCDD and PCDF emissions from regional sources.

> The above Miscellaneous Structure [i.e., Building 147] was constructed for an incinerator. However, it has never been used for an incinerator; performs no useful function, nor can it be feasibly converted to any other use.

The Army explains why the incinerator was never used in a memorandum, dated 25 February 1963 (Army, 1965):

> At the time the incinerator was designed and programmed, commercial firms were unable to handle the amounts of wet garbage generated by the Terminal [i.e., OARB]. Later, when the incinerator had been built, operations at the Terminal had been cut back to such an extent that it was uneconomical to operate the incinerator with the amount of wet garbage then generated. Also at this time, private firms were able to provide satisfactory removal service.

Therefore, PCDDs and PCDFs are not considered COCs outside of the former ORP / Building 1 area because no dioxin sources at the OARB have been identified or can be reasonably attributed to current or past activities at the OARB. Exclusion of PCDDs and PCDFs outside of the former ORP / Building 1 area are the only chemicals that were detected in greater than 5 percent of the samples but have been excluded as COCs in the RAP based upon historical use information.

5.3 IDENTIFIED COCS

Detected chemicals that remained after completing the screening steps described above were determined to be COCs for the property being transferred to OBRA via the EDC. Identified COCs in soil and groundwater at the former ORP / Building 1 area are listed in Tables 5-2 and 5-3, respectively. Identified COCs in soil and groundwater for the area outside the former ORP / Building 1 area that is subject to this RAP are listed in Tables 5-4 and 5-5. For reference, Tables 5-6 and 5-7 summarize the chemicals excluded as COCs in soil and groundwater as a result of COC screening. The COC database, edited to include data flags reflecting the COC screening described in this section of the RAP, is provided on a compact disc in Appendix A.

6

6. APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS

The release or threatened release of a hazardous substance into the environment provides the basis for all cleanups under Chapter 6.8 of the California HSC and related NCP requirements.

To create a list of regulated hazardous substances for CERCLA purposes, Congress incorporated substances, elements, compounds, solutions, or mixtures subject to other federal laws, such as RCRA, CWA, CAA, and TSCA. However, CERCLA, as it was enacted in 1980, did not specifically require remedial actions implemented at Superfund sites to comply with cleanup levels or management standards contained in these laws (U.S. EPA, 1988b). Instead, Congress established a risk-based threshold for cleanups at Superfund sites that was protective of human health and the environment but still afforded significant flexibility in selecting and implementing response actions (U.S. EPA, 1998c). In the absence of numerical cleanup levels and management standards specific to CERCLA, U.S. EPA implemented a policy that remedial actions generally meet or surpass substantive requirements of existing environmental laws, including those laws that Congress had referenced to generate the list of hazardous substances.

In 1986, SARA codified U.S. EPA's existing policy towards compliance with other environmental laws. As a result, the NCP at 40 CFR §300.430(f)(1)(i)(A) provides that releases of hazardous substances at a site be cleaned up to meet ARARs, unless circumstances for a waiver exist. ARARs are used in conjunction with risk-based remediation goals to establish cleanup levels as part of RAOs for a site. According to U.S. EPA (1991d), "ARARs represent the minimum that a remedy must attain; it may sometimes be necessary, where there are multiple contaminants with potentially cumulative and synergistic effects, to go beyond what ARARs require to ensure that a remedy is protective."

The purpose of this RAP is to develop remedial alternatives that are protective of human health and the environment, cost-effective, and consistent with planned reuse. Part of this process includes an evaluation of ARARs. Potential ARARs are evaluated generally for all identified RAP sites and RMP locations in this section. RAP sites and RMP locations also include any associated remote staging areas.[16] Table 6-1 summarizes ARARs for

[16] Remote staging areas are locations separate from the actual remedial site, which are used to implement the remedial activities at the site. Such activities could include contractor vehicle or equipment storage, stockpiling of excavated or

identified RAP sites and RMP locations, including legal citations and specific locations where an ARAR may be expected to apply. In the event of a discrepancy between the text and Table 6-1, the information in the table shall prevail.

6.1 EFFECT OF ON-SITE AND OFF-SITE REMEDIAL ACTIONS ON ARARs

The scope and extent of ARARs that pertain to remedial actions will vary depending based on the nature and source of contamination. This RAP will document compliance with substantive requirements of federal and state environmental laws identified as ARARs.

6.2 APPLICABLE REQUIREMENTS

The NCP at 40 CFR §300.5 defines applicable requirements as:

> ...those cleanup standards, standards of control, and other substantive requirements, criteria or limitations promulgated under federal environmental or state environmental or facility siting laws that specifically address a hazardous substance, pollutant, contaminant, remedial action, location, or other circumstance found at a CERCLA site. Only those state standards that are identified by a state in a timely manner and that are more stringent than federal requirements may be applicable.

An applicable requirement directly and fully addresses the situation at a site. In other words, an applicable requirement is one that a party would be subject to if it were undertaking the action independently from any CERCLA authority. For example, if any type of action, regardless if it occurs under CERCLA or not, entails injecting treated water into the uncontaminated saturated zone, then compliance with the SWRCB (1968) Resolution No. 68-16 ("Antidegradation Policy") is mandatory. For a requirement to be applicable, all jurisdictional prerequisites of the requirement must be met, including; (1) the party must be subject to the law; (2) the substances or activities must fall under the authority of the law; (3) the action must occur in the time period during which the law

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fill materials, soil or debris handling activities, or other activities required to implement the remedial action which are conducted at a location separate from the site. Action- and chemical-specific ARARs for remote staging areas will be the same as the ARARs for the primary site for which the activities are being staged; location-specific ARARs may be more or less stringent, depending on the location of the staging area.

is in effect; and (4) the action must be one of the types of activities the statute requires, limits, or prohibits (U.S. EPA, 1989a).

State requirements are ARARs only if they are more stringent than federal requirements. State requirements may be considered more stringent than federal requirements in the following ways (U.S. EPA, 1989b; SWRCB, 1992):

- The state is implementing a program that has a federal counterpart and the state program has received federal approval. An approved state RCRA program would be an ARAR because the state program has to be at least as stringent as the RCRA requirements for U.S. EPA to approve the program.

- The state program does not have a federal counterpart because the program has been established due to a state law only.

- State requirements are more stringent than federal requirements. More stringent state MCLs promulgated for drinking water would be ARARs.

State requirements must be identified in a timely manner to be considered as ARARs. The NCP at 40 CFR §300.515(h)(2) indicates that "in a timely manner" means as early as possible but at least before conducting detailed analysis of alternatives.

6.3 RELEVANT AND APPROPRIATE REQUIREMENTS

The NCP at 40 CFR §300.5 defines relevant and appropriate requirements as:

> ...those cleanup standards, standards of control, and other substantive requirements, criteria or limitations promulgated under federal environmental or state environmental or facility siting laws, that, while not "applicable" to a hazardous substance, pollutant, contaminant, remedial action, location, or other circumstance at a CERCLA site, address problems or situations sufficiently similar to those encountered at the CERCLA site that their use is well suited to the particular site. Only those state standards that are identified in a timely manner and are more stringent than federal requirements may be relevant and appropriate.

According to U.S. EPA (1989a), determining an ARAR is relevant and appropriate is "site-specific and is based on best professional judgment, taking into account the circumstances of the release or threatened release." Greater flexibility and discretion exists in determining that an ARAR is relevant and appropriate as opposed to it being applicable. U.S. EPA (1989a) states the following:

> Only those requirements that are <u>both</u> relevant and appropriate are ARARs. A requirement may be relevant, but not appropriate, because of site circumstances. Such a requirement would not be an ARAR for the site. Moreover, it is possible for only a portion of a requirement to be considered relevant and appropriate, while other parts may not.

Once a requirement, or part of a requirement, is determined to be relevant and appropriate, the substantive provisions are considered to the same degree as if it were applicable.

6.4 TO-BE-CONSIDERED MATERIALS

The NCP at 40 CFR 300.400(g)(3) describes To-Be-Considered materials ("TBCs") as advisories, criteria, or guidance that may be considered for a particular action or specific issue, as appropriate. TBCs are not ARARs and do not have to be achieved by remedial actions implemented at a site. U.S. EPA (1989a) states the following regarding TBCs:

> TBCs are not potential ARARs because they are neither promulgated nor enforceable. It may be necessary to consult TBCs to interpret ARARs, or to determine preliminary remediation goals when ARARs do not exist for particular contaminants. However, identification and compliance with TBCs is not mandatory in the same way that it is for ARARs.

Use of TBCs in developing CERCLA remedies is discretionary.

6.5 TYPES OF ARARs and TBCs

U.S. EPA (1989a) has divided ARARs (and TBCs) into the following three types to facilitate their identification:

- **Chemical-specific ARARs:** These ARARs are usually health- or risk-based numerical values or methodologies used to determine acceptable concentrations of chemicals that may be found in, or discharged to, the environment (e.g., MCLs that establish safe levels in potential drinking water).

- **Location-specific ARARs:** These ARARs restrict actions or contaminant concentrations in certain environmentally sensitive areas. Examples of areas regulated under various federal laws include locations where endangered species or historically significant resources are present.

- **Action-specific ARARs:** These ARARs are usually technology- or activity-based requirements, or limitations on actions or conditions involving specific COCs.

Chemical- and location-specific ARARs are generally identified early in the RI and remedy selection process, while action-specific ARARs are usually identified during the detailed analysis of remedial alternatives (U.S. EPA, 1988b). Table 6-1 is organized by chemical-specific, location-specific, and action-specific ARARs and TBCs.

6.6 POTENTIAL ARARs AND TBCs FOR OARB

CWA, TSCA, RCRA, and CAA, are some of the environmental laws with requirements that are frequently applicable or relevant and appropriate. ARARs and TBCs associated with these and other laws that pertain to identified RAP sites and RMP locations at the OARB are discussed below. The following discussion provides an overview of the ARARs and TBCs associated with these and other laws that pertain to RAP sites and RMP locations. Table 6-1 provides a more detailed analysis of the ARARs and TBCs that pertain to RAP sites and RMP locations, as well as a list of locations that may be subject to a specific ARAR or TBC. ARARs and TBCs in this table have been grouped by type. Numerical criteria associated with chemical-specific and action-specific ARARs are summarized in Tables 6-2 and 6-3, respectively.

6.6.1 Chemical-Specific ARARs and TBCs

Chemical-specific ARARs and TBCs that may pertain to RAP sites and RMP locations are described in Sections 6.6.1.1 through 6.7.3.

6.6.1.1 Clean Water Act

The CWA of 1972 is the principal federal law governing discharges to surface waters and adjoining shorelines. Even before passage of the CWA, the State of California was protecting its surface water and groundwater through enactment of the Porter-Cologne Water Quality Act ("Porter-Cologne") under the California Water Code in 1967. The SWRCB and nine Regional Boards are responsible for oversight of Porter-Cologne and

CWA requirements. Unlike the CWA, Porter-Cologne does not restrict water quality standards to surface waters and point source discharges authorized by NPDES permits. Porter-Cologne requires that each of the nine Regional Boards adopt *Water Quality Control Plans*, which are applicable to groundwater and non-point sources, as well. *Water Quality Control Plans* are often called Basin Plans because they apply to waters within specific watershed boundaries or drainage basins. The Basin Plan and SWRCB resolutions that have been promulgated to implement Porter-Cologne and CWA requirements, and that pertain to remedial actions at RAP sites and RMP locations, are discussed below.

6.6.1.1.1 RWQCB Water Quality Control Plan

The RWQCB's (1995) *Water Quality Control Plan* sets forth narrative standards and permissible concentrations of organic and inorganic chemical constituents for various types and beneficial uses of surface water and groundwater in the San Francisco Bay Area. These narrative standards and concentration limits are **chemical-specific ARARs** that are or may be **applicable** to certain OARB locations.

6.6.1.1.2 California Toxics Rule

The following plans prepared by SWRCB provided water quality criteria for toxic compounds in enclosed bays, estuaries, and inland surface waters throughout California:

- SWRCB. 11 April 1991. *California Enclosed Bays and Estuaries Plan, Water Quality Control Plan for Enclosed Bays and Estuaries of California* ("EBEP").

- SWRCB. 11 April 1991. *California Inland Surface Waters Plan, Water Quality Control Plan for Inland Surface Waters of California* ("ISWP").

RWQCB enforced the criteria in these plans from 1992 to 1994, at which time the Superior Court of California ordered that numerical water quality criteria in the EBEP and ISWP be rescinded based upon a legal challenge by various municipalities and regulated industries in the state. To replace the standards that were rescinded, U.S. EPA has issued new freshwater and saltwater quality criteria for inland surface waters, enclosed bays, and estuaries in California. These new water quality criteria became effective on 18 May 2000 and are promulgated under 40 CFR §131.38, *Establishment of Numerical Criteria for Priority Toxic Pollutants for the State of California*, also known as the California Toxics Rule ("CTR"). SWRCB (2000) has adopted measures to implement these criteria throughout California.

As discussed in Section 3.5.2, available data do not indicate that COCs in groundwater at the OARB are migrating in the shallow water-bearing zone to San Francisco Bay. However, it is possible that groundwater migrates to San Francisco Bay through storm drain piping. Storm drain piping at the OARB is documented to have breaks and cracks. Storm drain piping is often situated in the saturated zone and groundwater may enter the cracked or otherwise breached storm drain piping. In the event that COCs originating from releases at the OARB are found to be impacting water in the bay, the California Toxics Rule is a **chemical-specific ARAR** that is or may be **applicable** to OARB locations.

6.6.1.2 Toxic Substances Control Act

TSCA was enacted in 1976 to regulate the introduction and use of new hazardous chemicals. TSCA was amended in 1987. As part of these amendments, U.S. EPA added Subpart G that established criteria to determine the adequacy of cleanup of PCB spills. U.S. EPA has concluded that Subpart G is a potential TBC for PCBs released at Superfund sites (U.S. EPA, 1998c, 1990b, 1989c).

Requirements governing cleanup of PCB-containing soil and wastes were broadened by amendments to TSCA in 1998. As part of these amendments, U.S. EPA added 40 CFR §761.61 to Subpart D of TSCA, which provides cleanup and disposal provisions for PCB-containing soil and other types of remediation wastes. Subpart D requires that excavated soil that contains greater than 50 mg/kg of PCBs be managed as a RCRA or TSCA waste. In addition, this section of Subpart D sets cleanup levels for high occupancy areas (e.g., residence) and low occupancy areas (e.g., electrical equipment vaults and unoccupied areas outside a building). The cleanup level for unrestricted use of high occupancy areas is 1 mg/kg of PCBs in soil and the cleanup level for unrestricted use of low occupancy areas is 25 mg/kg of PCBs in soil. A PCB cleanup level of 10 mg/kg for high occupancy areas is permissible if the areas impacted by PCBs are capped and accompanied by land use restrictions. Higher cleanup levels for low occupancy areas are also allowed if the areas impacted by PCBs are either fenced or capped and accompanied by land use restrictions. The PCB cleanup level for low occupancy areas is 50 mg/kg for areas that are fenced and 100 mg/kg for areas that are capped and where land use restrictions are placed into effect.

Although U.S. EPA (63 FR 35407) considers Subpart D to be an ARAR, 40 CFR §761.61(a)(1)(ii) indicates that these requirements are not binding upon CERCLA remedial actions. Cleanup of PCBs to more stringent levels can be enforced. Subpart D of TSCA is a **chemical-specific ARAR** that is or may be **relevant and appropriate** for certain RAP sites and RMP locations at OARB. The Subpart G spill cleanup policy is a **chemical-specific** policy that is or may be a **TBC** for certain OARB locations.

6.6.1.3 Fuel Storage Tank Sites Cleanup Levels

RWQCB is the lead agency supervising closure of former petroleum tank locations at the OARB. Under RWQCB oversight, the Army developed cleanup levels for petroleum hydrocarbons and related constituents in soil and groundwater to assist with closing former tank locations at the OARB (IT, 2001g 2000h). These remediation criteria were designated Fuel Storage Tank Sites Cleanup Levels. Fuel Storage Tank Sites Cleanup Levels are **chemical-specific TBCs** for OARB locations.

6.6.1.4 Oakland Urban Land Redevelopment Program

The ULR (Oakland, 2000) is the result of a collaborative effort between the City of Oakland and the principal agencies that enforce environmental regulations. Participating agencies included DTSC, RWQCB, U.S. EPA, and Alameda County Department of Environmental Health. Creation of the ULR program was funded by U.S. EPA Region IX and is intended to facilitate the cleanup and redevelopment of contaminated properties.

The ULR program is a three-tiered risk-based corrective action process. Tiers 1 and 2 consist of numerical cleanup levels in "look-up" tables that are applicable to properties that involve particular land uses, types of chemical releases, and geologic and hydrogelogic conditions. Tier 3 of the ULR program outlines a methodology for calculating site-specific remediation goals that incorporate human health exposure parameters that are specific to Oakland.

Tiers 1 and 2 of the ULR program are not pertinent because risk-based remediation goals have been calculated for the OARB as discussed in Section 7.3. These risk-based remediation goals were derived using risk equations and exposure parameters from U.S. EPA, DTSC, and the City of Oakland ULR program. Tier 3 of the ULR program is considered a **chemical-specific TBC** for OARB locations.

6.6.1.5 RWQCB Risk-based Screening Levels

RWQCB (2001a) has released interim final soil and groundwater risk-based screening levels ("RBSLs") for over 100 chemicals commonly found at sites where releases of hazardous substances have occurred. RBSLs are used primarily to evaluate whether a chemical release may pose a risk at the site that warrants further investigation. In addition, RBSLs can be used, if appropriate, as cleanup levels if site-specific cleanup levels are not available. Use of RBSLs for RAP sites and RMP locations at the OARB may be appropriate under circumstances where site-specific, risk-based remediation goals do not apply (Section 7.3). For example, risk-based remediation goals for the OARB do not take into account further degradation of the shallow water-bearing zone caused by COCs leaching from soil. RBSLs have been generated for such situations and therefore are included as **chemical-specific TBCs** for OARB locations.

6.6.2 Location-Specific ARARs and TBCs

Location-specific ARARs and TBCs that may pertain to OARB locations are described in Sections 6.6.2.1 through 6.7.8.

6.6.2.1 RWQCB Water Quality Control Plan

The Basin Plan sets forth discharge prohibitions throughout the San Francisco Bay Region (RWQCB, 1995). In addition, the Basin Plan reaffirms the California Wetlands Conservation Policy of ensuring no net loss of wetlands. Certain provisions of the Basin Plan identified in Table 6-1 are **location-specific ARARs** that are or may be **applicable** for some of the OARB locations.

6.6.2.2 SWRCB Resolution No. 88-63

SWRCB Resolution No. 88-63 – *Adoption of Policy Entitled "Sources of Drinking Water"* states that all surface water and groundwater in California should be designated suitable, or potentially suitable, sources of drinking water unless the surface water or groundwater contains greater than 3,000 mg/L of TDS, is not capable of producing an average, sustained yield of 200 gallons per day, or has naturally high concentrations of contaminants. Groundwater in the shallow water-bearing zone and Merritt Sand beneath the OARB are not potential drinking water supply because TDS concentrations are greater than 3,000 mg/L and often 10,000 mg/L. RWQCB has proposed formal de-designation of groundwater along the Oakland shoreline, including the OARB, as potential municipal supply based upon Resolution No. 88-63.

U.S. EPA (1986) has developed guidelines for determining future use of groundwater at a site for purposes of evaluating the appropriateness of remedial actions under CERCLA. However, U.S. EPA (1997i) will generally defer to a state's groundwater use determination (e.g., Resolution No. 88-63), provided it results in cleanup levels that are at least as stringent as would be derived using U.S. EPA's groundwater classification guidelines. Therefore, to the degree Resolution No. 88-63 is more stringent than the federal standards, it is a **location-specific ARAR** that is or may be **applicable** for OARB locations.

6.6.2.3 National Historic Preservation Act

The federal National Historic Preservation Act ("NHPA") requires consideration of the potential effects that remedial actions will have on historic properties included, or eligible for inclusion, on the National Register of Historic Places ("National Register"). The National Register lists historic properties (i.e., cultural resources), which consist of districts, sites, buildings, structures, and objects that are significant in American history or culture for their architectural, archeological, engineering, or other aspects (U.S. EPA, 1989c). While portions of the OARB are included in a registered historic district because of the role the OARB played during World War II and later military conflicts, none of the buildings on the OARB are listed on the National Register. The Army has completed the NHPA consultation process in connection with its Environmental Impact Statement ("EIS") supporting the transfer of the OARB to OBRA for implementation of the Amended Reuse Plan, and a Programmatic Agreement has been entered into by all relevant parties to assure compliance with NHPA requirements. The EIS was prepared to fulfill requirements of the National Environmental Policy Act ("NEPA"). The substantive requirements to survey sites for, and minimize harm to, cultural resources are **location-specific ARARs** that have already been complied with in connection with the OARB locations.

6.6.2.4 Archeological and Historic Preservation Act

The federal Archeological and Historic Preservation Act provides for conservation of historical and archeological data that might otherwise be destroyed as a result of construction projects. If such a project may cause irreparable loss or destruction to significant scientific, pre-historical, historical, or archeological data, the Archeological and Historic Preservation Act requires that the agency undertaking the project preserve the data or request the Secretary of the Interior to do so (U.S. EPA, 1989c). The Archeological and Historic Preservation Act differs from the NHPA in that it encompasses a broader range of resources than those listed on the National Register and mandates only the conservation, analysis, and publication of the data, as opposed to preservation of the resources or artifacts themselves. The Archeological and Historic Preservation Act is a **location-specific ARAR** that is or may be **applicable** for OARB locations. As with the NHPA requirements discussed in Section 6.6.2.3, the Army's completed NEPA process has already resulted in compliance with the Archeological and Historic Preservation Act such that there will be no irreparable loss of historical or archeological resources in connection with the remediation and redevelopment of OARB.

6.6.2.5 Archeological Resources Protection Act

The Archeological Resources Protection Act ("ARPA"), prohibits excavation of, damage to, or destruction of archeological resources on public lands without a permit issued by the federal land manager. However, no permit is required if the activities in question take place under another permit, license, or entitlement for use, and the activities are exclusively for purposes other than the excavation and removal of archeological resources. The ARPA is a **location-specific ARAR** that is or may be **applicable** for OARB locations. The Army's completed EIS process, and its completed consultation with the State Historic Preservation Officer, has verified that there are no archeological resources at OARB.

6.6.2.6 Native American Graves Protection and Repatriation Act

The Native American Graves Protection and Repatriation Act ("NAGPRA") requires that when a planned activity results in the movement or excavation of human remains, funerary objects, sacred objects, or objects of cultural patrimony from federal land, the Indian tribes or Native Hawaiian organizations that are likely to be culturally affiliated with the artifacts must be notified and consulted regarding the appropriate treatment of the discovery. Following such a discovery, work in this area must cease immediately, and the discovery must be reported to the responsible federal land manager. The EIS indicates that Native Americans subsisted by hunting and gathering food from the marshlands that existed along the Oakland shoreline as long as 5,000 years ago. Although no Native American cultural artifacts have been discovered at the OARB, the NAGPRA is a **location-specific ARAR** that is or may be **applicable** for RAP sites and RMP locations at the OARB in the event that Native Americans human remains or artifacts are unexpectedly encountered.

6.6.2.7 Coastal Zone Management Act

The federal Coastal Zone Management Act ("CZMA") requires that activities directly affecting the coastal zone be performed in a manner that is consistent with the state coastal zone management plan. The San Francisco Bay Conservation and Development Commission ("BCDC") is responsible for administering the CZMA for the portion of the California coast within the San Francisco Bay.

Before 1965, roughly 2,300 acres of San Francisco Bay were being filled each year. BCDC was established in 1965 under the McAteer-Petris Act to regulate development in and around San Francisco Bay. BCDC's jurisdiction extends to the first 100 feet from the shoreline around San Francisco Bay, and to most creeks, rivers, sloughs and other tributaries that flow into San Francisco Bay ("BCDC jurisdictional area"). BCDC became the federally designated state agency for conservation of San Francisco Bay with passage of CZMA in 1972.

BCDC, in cooperation with the Metropolitan Transportation Commission, implements the *San Francisco Bay Area Seaport Plan* ("Seaport Plan"). Under the Seaport Plan, the former Baldwin Railyard and Port Development Area of the OARB are designated Port Priority Use Areas. These areas must be used for maritime terminals and other authorized maritime activities.

Remedial actions performed in areas under the jurisdiction of BCDC must comply with the substantive requirements of the CZMA, Seaport Plan, and BCDC's *San Francisco Bay Plan* ("Bay Plan"), and may require may require a BCDC permit (particularly in connection with any excavation or other construction activities in the subsurface area or otherwise in the BCDC jurisdictional area). The CZMA and BCDC's Seaport Plan and Bay Plan are **location-specific ARARs** that are or may be **applicable** for certain OARB locations.

6.6.2.8 Migratory Bird Treaty Act

The federal Migratory Bird Treaty Act and the California Fish and Game Code prevent the taking, killing, or possessing of migratory and other fully protected birds, and their nests, eggs, and young unless permitted by the Secretary of the Interior. Loss of certain trees during nesting season may disrupt breeding birds. Consequently, where remedial actions may necessitate the removal of trees, the Migratory Bird Treaty Act and certain requirements of the Fish and Game Codes regarding protection of birds are **location-specific ARARs** that are or may be **applicable** for certain OARB locations.

6.6.2.9 Amended Reuse Plan

The Amended Reuse Plan describes intended redevelopment of the OARB. Remedial actions implemented at the OARB should be compatible with the land uses described in this document. The Amended Reuse Plan is considered a **location-specific TBC**.

6.6.3 Action-Specific ARARs and TBCs

Action-specific ARARs and TBCs that may pertain to RAP sites and RMP locations at the OARB are described in Sections 6.6.3.1 through 6.7.9.

6.6.3.1 Basin Plan and SWRCB Resolution No. 68-16

The RWQCB's (1995) *Water Quality Control Plan* outlines strategies to achieve the state's policy of maintaining the existing high quality of surface water and groundwater in the San Francisco Bay Area. As discussed in Section 6.6.2.2, this policy is set forth in the SWRCB's Antidegradation Policy. The Basin Plan identifies beneficial water uses and adopts water quality criteria to protect those uses. The Basin Plan contains numerical limits for conventional pollutant objectives (e.g., dissolved oxygen, temperature, pH), and limits for metals and PAHs in discharges to freshwater and saltwater in the San Francisco Bay Area.

The CWA requires every state to establish surface water antidegradation regulations (U.S. EPA, 1990a). Although not specifically required by U.S. EPA, the majority of states have also established some form of groundwater antidegradation provisions. The State of California's Antidegradation Policy is set forth in SWRCB Resolution No. 68-16, *Statement of Policy with Respect to Maintaining High Quality of Waters in California*, which pertains to both surface water and groundwater. Resolution No. 68-16 applies to CERCLA remedial actions that involve extracting, treating, and discharging treated groundwater. Under this resolution, no discharge of chemical-containing groundwater is allowed to high quality groundwater (i.e., groundwater that contains only naturally occurring substances), unless it is in the public interest to allow such a discharge. If discharge of groundwater is allowed, Resolution No. 68-16 states that the groundwater or waste must:

> ...meet waste discharge requirements which will result in the best practicable treatment or control of the discharge necessary to assure that (a) a pollution or nuisance will not occur and (b) the highest water quality consistent with maximum benefit to the people of the State will be maintained.

RWQCB enforces this policy by issuing waste discharge requirements for treated water that is reinjected or allowed to percolate into the subsurface and NPDES permits for treated water that is pumped directly to streams, lakes, or other water bodies.

Waste discharge requirements may also be issued to chemical-containing soil to protect the beneficial uses of groundwater and surface water from COCs that may leach or otherwise migrate from impacted soil. RWQCB (1995) states in its Basin Plan that its objective is to have COCs released to soil removed or treated to naturally occurring or ambient concentrations. For those RAP sites and RMP locations where it is impracticable to remove COCs to ambient concentrations in soil, RWQCB will consider site-specific recommendations for cleanup levels based upon the physical characteristics of the site, and mobility and toxicity of chemicals released. Certain sections of the Basin Plan addressing effluent limitations and groundwater discharge and Resolution No. 68-16 are **action-specific ARARs** that are or may be **applicable** for specific OARB locations.

6.6.3.2 SWRCB Resolution No. 92-49

Section 13304 of the California Water Code authorizes the Regional Boards "to require complete cleanup of all waste discharged and the restoration of affected water to background conditions (i.e., the water quality that existed before the discharge)." If background conditions of affected water cannot be attained, then the water shall be restored to the best quality that is reasonable. To assist Regional Boards with oversight of this law, SWRCB promulgated Resolution No. 92-49 – *Policies and Procedures for Investigation and Cleanup and Abatement of Discharges under Water Code Section 13304*. This resolution establishes policies and procedures for investigating and remediating chemical releases that affect or threaten water quality. Resolution No. 92-49 is an **action-specific ARAR** that is or may be **applicable** for some OARB locations.

6.6.3.3 EBMUD Sanitary Sewer Discharge Limitations

EBMUD operates the publicly owned treatment works ("POTW") to which sanitary sewage from the OARB is conveyed. EBMUD Board of Directors have established restrictions pertaining to the discharge of wastewater to the POTW. These restrictions include numerical discharge limitations for certain COCs at the OARB as summarized in Table 6-3. These limitations are **action-specific ARARs** that are or may be **relevant and appropriate** for certain OARB locations.

6.6.3.4 Resource Conservation and Recovery Act

Enacted in 1976, RCRA established the first comprehensive federal program for controlling hazardous waste. RCRA emphasizes the conservation and recycling of wastes whenever practical. RCRA also sets standards for the handling of hazardous wastes within a cradle-to-grave framework that originates with the generator and follows the wastes through its handling, transportation, treatment, and final disposal (Wentz, 1989). Congress significantly broadened the scope of RCRA through passage of the Hazardous and Solid Waste Amendments ("HSWA") in 1984. HSWA introduced several new requirements, including new standards for the construction and operation of solid waste management units, and upgraded criteria for disposing of municipal solid wastes in landfills. Municipal solid wastes are defined to be non-hazardous solid wastes in the State of California. Classification of hazardous and non-hazardous waste, and requirements governing management and disposal of these wastes off-site, are further discussed in Section 8.2.6.

6.6.3.4.1 Hazardous Waste Requirements Under Title 22 of CCR and HSC §25157.8

RCRA Subtitle C (40 CFR §§260-299) sets forth criteria for determining what are federal hazardous wastes, and specifies minimum national requirements for facilities that generate, transport, store, or dispose of hazardous wastes. DTSC has promulgated regulations in Title 22 of the CCR that govern the management of wastes that are hazardous under RCRA or are hazardous under criteria specific to California for the definition of hazardous wastes. These latter types of hazardous wastes are referred to as non-RCRA hazardous wastes, and include wastes that contain metals or organic compounds at concentrations greater than their respective Total Threshold Limit Concentration ("TTLC") or Soluble Threshold Limit Concentration ("STLC"), as measured by the Waste Extraction Test ("WET"). TTLC and STLC limits for COCs at RAP sites and RMP locations at the OARB are summarized in Table 6-3.

Pursuant to HSC §25157.8, additional criteria pertain to the management of lead, copper, or nickel contaminated waste. Waste containing total lead greater than 350 mg/kg, copper greater than 2,500 mg/kg, or nickel greater than 2,000 mg/kg must be disposed at a permitted hazardous waste management facility, unless the waste discharge requirements and solid waste facility permit of a non-hazardous waste management facility specifically allow for the disposal of these types of wastes. HSC §25157.8 remains in effect until 1 July 2006, and as of that date is repealed unless a later statute is enacted that repeals or extends the 1 July 2006 sunset provision.

Although the majority of wastes and soil to be generated by remedial actions performed at the OARB are anticipated to be non-hazardous, the possibility exists that some materials may be managed as hazardous waste. The tarry residue at the former ORP / Building 1 area may fall within this category. Available data suggest that some portion of the tarry residue may be classified as a hazardous waste due to corrosivity or toxicity. Hazardous waste requirements under Title 22 of the CCR, generation, transport, and disposal regulations; and closure, maintenance, and land use restrictions, are **action-specific ARARs** that are or may be **relevant and appropriate** for the former ORP / Building 1 area and other RAP sites and RMP locations at the OARB.

6.6.3.4.2 Non-hazardous Waste Requirements Under Title 27 of CCR

RCRA Subtitle D (40 CFR §§257-258) specifies minimum national requirements for municipal solid waste landfills that apply to new and existing waste management units that have received such wastes after 9 October 1991. Prior to the development of these national requirements, the SWRCB and the California Environmental Protection Agency's Integrated Waste Management Board promulgated regulations in Titles 14 and 23 of the CCR that pertain to the management of non-hazardous wastes and municipal solid waste landfills. Titles 14 and 23 of the CCR were amended to incorporate RCRA Subtitle D and approved for implementation by U.S. EPA. The State of California subsequently consolidated most of the requirements in Titles 14 and 23 that relate to non-hazardous wastes under Title 27 of the CCR. Non-hazardous waste requirements under Title 27 of the CCR are **action-specific ARARs** that are or may be **relevant and appropriate** for some OARB locations.

6.6.3.5 Clean Air Act

The CAA consists of numerous long-standing regulatory requirements with new requirements layered on top that can be likened to a patchwork quilt (Elsevier Science, Inc., 1995). The first federal air pollution-related statute was established in 1967, although not a great deal of regulatory activity resulted. The CAA of 1970 consisted of amendments to the legislation passed in 1967 and laid the foundation for the federal air pollution regulatory programs in existence today. Further amendments to the CAA were passed in 1977 and 1990. A key concept in the federal approach to maintaining and improving ambient air quality involves the relationship between federal and state regulatory agencies. Although the CAA sets overall standards for the nation, the states ultimately have primary responsibility for achieving compliance with these standards. In essence, state regulatory agencies make things happen.

State compliance with the CAA is based upon a State Implementation Plan ("SIP") that designates regions for effective air quality management, and contains enforceable provisions to attain compliance with ambient air quality standards and other federal emission limitations. The SIP incorporates rules and regulations of the state and local districts involved in air pollution control. The California Air Resources Board is responsible for developing the SIP and ensuring that local air pollution control districts are complying with the plan. County and unified air pollution control districts enforce the SIP through permitting and regulation of emissions from stationary and mobile sources. The Bay Area Air Quality Management District ("BAAQMD") is the local regulatory agency responsible for maintaining and improving air quality in the San Francisco Bay Area.

Available soil and groundwater analytical data compiled for RAP sites and RMP locations at the OARB do not suggest that COCs are at high enough concentrations in undisturbed media to volatilize or otherwise become airborne at levels that would be